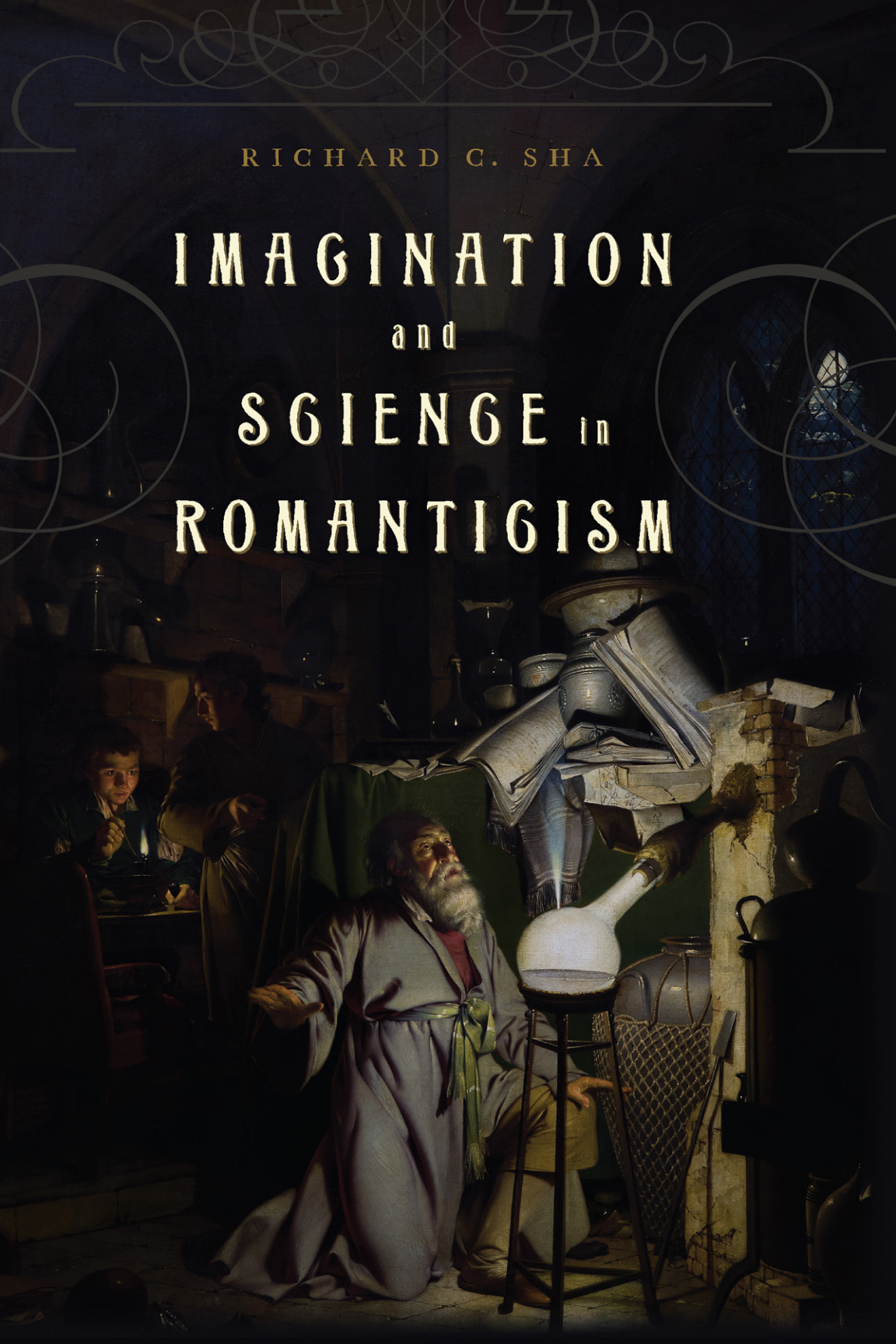
RICHARD C. SHA

IMAGINATION and SCIENCE in ROMANTICISM



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Imagination and Science in Romanticism

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IMAGINATION
AND
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ROMANTICISM

Richard C. Sha

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For
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extraordinary teacher, for whom matter is beauty and truth,

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superb scholar, may he forgive what he does not approve,

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for loving the author despite his obsessions (like this book)

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Imagination and Science in Romanticism

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Introduction

My aim here is to restore connections between Romantic literature and science through one of the period's key terms: "imagination." The popular account of Romanticism still maintains that hostility to science is a unifying attitude of the period (Heringman, *Romantic Science* 7). In recent years, work on Romantic science has become a virtual cottage industry, but we still lack an overall sense of how scientific ideas undergird the Romantic imagination and how that undergirding changes what we think we know about it.[1] Science and art were more compatible then, and this study shows why. Adding to the problem: within literary studies, the imagination itself has been discredited for its false idealism and its misleading promises of autonomy.[2] I show how this dismissal has been too hasty, in part by challenging both the traditional view of the imagination and the version of the Romantic imagination that historicism has left us with.

THE ROMANTIC TURN TO PHENOMENALITY AND THE USES OF FORM

In brief, the main claim of this book is that both Romantic artists and scientists seized upon the imagination to connect more fully with the experience of objects, not to leave them behind, and thus "transcendence" could not automatically separate art from science.[3] Kant, of course, meant by "transcendental" all the necessary conditions of experience.[4] Physician John Abercrombie, to cite only one of many hundred possible instances, wrote, "The power of invention, founded on exercise of the imagination, may also be applied to the investigations of science . . . [I]t may be employed, for example, in the contrivance of experiments, calculated to aid investigation, or to illustrate a doctrine; and in the construction of

those legitimate hypotheses, which have often led to the most important discoveries" (*Inquires* 162). Imagination operated, on the one hand, as hypothesis, to link literary creation with the creation within scientific discovery.[5] Lorenz Oken in *Die Zeugung* (1805) imagines "the complex living organism as an association of simple living organisms" (Jacob 115), and this prepared the way for cell theory.[6] On the other hand, imagination operated to bracket ontology as beyond what it is possible to know, since, after Kant, the thing-in-and-of-itself was considered widely to be outside epistemology.[7] Joseph Priestley refers to experimental results as "appearances," and he goes so far as to "imagine" a theory to account for the chemical process he thinks he has just witnessed ("Experiments" 301).[8] Naturalist Charles Bonnet insists that "tout le Système matériel ne seroit qu'un Phénomène, une pure apparence" (*Collection Complète* 7: 7), and he believes there was no break in the continuity of existence.[9]

Together, these modes of operation facilitated the rise of phenomenality over ontology, even within science, enabling both to seek the Kantian transcendental, or knowledge of what human faculties could know based upon rules to ensure knowing, while remaining either agnostic or modest about ontology. Claims bracketed by phenomenality and form—highlighting the observer's sensibility—could claim a modesty that was befitting the work of science.[10] Organic understandings of bodies rendered them into transitional states, heightening the importance of phenomenology. Since the representation of the thing was at issue, concepts could remain when they bespoke what was necessary for human experience writ large, enabling the reading of appearances as experiences that tell us something both about the world and about our cognitive powers.[11] The Romantic method for dealing with subjectivity was to actively factor it into the equation and to face it squarely and, only after doing so, temper it with the absolute, whose totalizing scale dwarfed the self and potentially countered its narcissism.[12]

The images and ideas of imagination became nearly impossible to dispense with. They could point to new ways of seeing previously unknown forms of what the Romantics considered matter, like electromagnetism; relate those forms of matter to natural laws of dynamism; and thus help explain how our senses could encounter them.[13] Hazlitt thought the imagination itself worked like a "lodestone, . . . moulded into itself by elective affinity," thus linking its creative combinations to science, magnetism, and the powers of attraction of chemical entities, thereby lending association the power of a natural law ("Table Talk" 6: 47).[14] Kant stipulated that the imagination could make images that were not present, either through invention or through abstraction (Makkreel 13),[15] and the power of abstraction could also help enable particularities to be apprehended as law. Indeed,

Romantic science unified heat, light, magnetism, and gravity under the "single fungible currency of energy" (Daston, "When Science" 1).[16] Nonetheless, to do so, one had to imagine and define "energy" as the entity pulling it all together.[17] In its strongest form, the imagination's ability to see relationality among differences could become what William Whewell, author of two monumental works on the history and philosophy of science, would soon call "consilience," the bringing together of previously separate streams of research to make something new.[18]

To the extent that Romantic literature and science looked to imagination to embrace this turn to phenomenality, the feltness of experience, over ontology, both could share the aesthetic project of bracketing objects and materiality in terms of appearances and forms.[19] Lecturing future physicians, John Gregory warned in 1772, "Many feeble attempts have been made to explain the phenomena of the animal body upon mechanical and chemical principles alone; but without success" (*Lectures* 189). The way forward was to try to study the laws of the nervous system because this would unlock "the mutual influence of mind and body" (189).[20] Michael Faraday explicitly invoked "forms" over objects as he lectured his chemistry students: the goal "of our philosophy cannot truly be enclosed in or confined to one form and that of the form under which we lay it down:—it has relations running in a thousand different directions" ("Syllabus" J9, page 2).[21] Such bracketing had several scientific and aesthetic advantages: objects acquired provisional status to be fodder for rational argument if not confirmed by experiment; objects thus had to be imagined as having some relationality to the subject as well as to other objects; and, indeed, in this view, there is no knowing outside of relationality.[22] Faraday exploits this way of thinking to develop a series of experiments, and form, because it is metonymic of relationality, insists on research as process. Even phenomena that look dissimilar might when considered together provide insight into laws: here, form corrals difference and minimizes it as it moves from lower to higher apprehension. Coleridge, we recall, understood method to amount to the contemplation of "the relations of things," especially the bringing of "things the most remote and diverse . . . into mental contiguity" (*Friend* 1: 451, 455).

Goethe even thought that he could develop a rigorous science of form (*Gestaltbildung*) with prolonged observation (Heitler 61). His transcendental anatomy stipulated an ideal, not actual, archetype that would regulate those observations of the "changing of one form into another" in plants (Goethe, *Metamorphosis* 6), and this led him to coin the term "morphology."[23] When he sees in winged seeds "the traces of such incompletely adapted leaf forms" (75), we witness just how much work imagination must do, as it must overcome traces, incompletion, and partial adaptation. Like Goethe, Friedrich Schlegel thinks that art became

perfect to the extent it was a science and vice versa (Beiser, *Imperative* 15). Finally, Romantic art as formal illusion could add a reflective dimension to what it was possible for science and art to know, even as the idea of form provided a way for scientists and artists to negotiate difference as appearance.[24]

Hence, imagining through form was useful for both scientists and artists alike, who saw it as a means to apprehension, and as a kind of "plausible empiricism." Kwame Appiah defines this term as a "disciplined connection between observation and occult properties, rather than a verificationalist confirmation of every occult property" (65). Because form can proffer visualizability yet is aware that it is only representation, its status as appearance provides visual plausibility while suspending questions of ontology.[25] Form can respond meaningfully to these lowered stakes in Romanticism by offering discipline in terms of the multiple kinds of relationality stemming from both careful observation and imagined connections, but only so long as these have the potential to shed light on either the absolute or on natural laws. When Kant stipulated that our scientific accounts of objects must include our ability to experience them, he underscored the importance of considering plausibility. And, since living things were structured and simultaneously changing constantly, form stepped in to adjudicate between these solid and liquid poles. To the extent that "form" lacks a pre-given scale and, after epigenesis, given structure, it was an ideal placeholder for a dynamic unit of organization, what would become the cell.[26]

This simultaneous shift to both phenomenality and relationality was, moreover, assisted by the general turn in empiricism during Romanticism, moving from an Enlightenment focus on parts to Romanticism's fascination with the relationships between parts that give the whole its meaning (Jacob 74). For Geoffroy Saint-Hilaire, thinking in terms of forms of animality encouraged him to make comparisons across species and to try to pin down the plan of organization itself, which, in turn, enabled his contribution of the term "homology" (Gil 194; Rehbock 149). These new tools of morphology and homology help make relationality into a science.[27] For Alexander von Humboldt, whose lush descriptions of Latin America fueled Charles Darwin's wanderlust, "Organic life is unceasingly occupied with connecting to new forms those elements liberated by death" (158).[28] Humboldt's emphasis on *Ansichten* meant that the project of recognizing connections within the web of life was just beginning, and he invites readers to activate their imaginations to move beyond natural history and toward geography, which attended to plants and their environment (Nicolson 170). He thus closes his "Ideas for a Physiognomy of Plants," the central essay in the volume, by invoking "the power of our imagination [to] create a living picture of exotic Nature" (Humboldt 169), even

as he renders nature into a "global force with corresponding climate zones across continents" (Wulf 103).[29] Because it remains a black box—the imagination is here papered over by the term "power," whose workings require its own summons—phenomenality encourages an ethos of modesty surrounding its claims.[30] More to the point, seeing aesthetically through the imagination provided the basis of what Kant called judgment: the ability to unify the particular with the universal through abstraction while at the same time allowing for the contingent to have shaped any current view of the universal.[31] Form acquires such power because its lack of scale facilitates this slide between the particular and universal, one that becomes necessary because universality is infinite, and therefore beyond empiricism's reach, and because laws exceed particularity.

Hence, the natural world and the literature about it become a sequence of reinterpretations and observations reconfiguring relationality that are not an obstacle to understanding but rather the precondition of it; and here the Romantics anticipate Heidegger's rendering of *Dasein*, or the being of being, into a hermeneutic.[32] De Quincey went so far as to define human nature as "some subtle nexus, some series of links, that we cannot perceive" (13: 178). And nature comes to be understood as an organism, and this overarching postulate allowed local differences to be subsumed by organic form even as phenomenality encourages the felt intensification of difference to heighten the quest for the absolute. Anna Barbauld in "A Summer Evening's Meditation," thus, figures deep space as "embryo systems and unkindled suns/sleep[ing] in the womb of chaos" (lines 97–98). If the world is an organism, hierarchy becomes logically absurd, since "every phenomenon is an indispensable part of the whole and equal to all the others" (Modiano 145). As a result, scientists were expected to have an account of the intelligibility of matter, how the subject encounters the object. Without such an account, the entity in view risked impossibility. This account, in turn, entailed a necessary modesty about claims of physicality beyond claims of relationality, which could contribute to the Romantic project of indicating a future ultimate order and unity.[33]

Coleridge had these complexities in mind when he considered chemical elements as neither actual physical bodies nor principles or powers of nature: instead, he thought of them as "symbols of the operation and degree of dominance of given powers of nature" (Modiano 172). He thus aligns what we would consider the materiality of chemical elements with a symbolism that operationalizes them into natural law. In Romanticism, the concept of relative atomic weight ratio was analogous: John Dalton may have come up with the idea, but his calculation of it relied upon interpreting the chemical experiments of others and often guessing the atomic structure of the compound and then basing proportionality upon that

guess. Dalton was careful to use the term "imagine" both when speculating upon the actual combinations in the production of compounds—as when he "should imagine" the oxidation that produces soda to be "one-to-one" (*New System* 2: 56)—and when speculating upon the reasons why certain combinations did not happen in nature (2: 101). Dalton thus turns to imagination because it allows him to bracket his claims as speculative and therefore needing the confirmation of either known analogies or systematic observations or calculations or experiments.[34] Crucially, this ratio is now considered symbolically as not to have actual weight (De Bievre and Peiser).

At the same time, such speculations could leverage the quality of usefulness if they followed rules or were systematically and logically applied, or at very least opened themselves up to experimental contradiction,[35] and, in a larger view, this meant that imagination did not function as the necessary antithesis to rules or logic.[36] Romantic creativity without order cancelled itself: consider here Coleridge's "Dejection" and the devastating loss of his "shaping spirit of Imagination" (366, line 86). Even wild Pindaric odes need shape. In his *Logic*, Coleridge argued that "'science' being taken in its highest sense, as any kind or quantum of knowledge that has been reduced to rules" (5). Indeed, the imagination raises the problem of judging how to produce rules that would discipline it, what Marc Redfield has called "judging judgment" (7), and Kant limited all a priori synthetic principles to "principles of possible experience" (*PMN* 314).[37] As Kant voluminously showed, if anything required rules, it was the idea of possible experience.[38] Without it, Kant thought that all the imagination could do would be to rave wildly.[39] William Hazlitt argued that "logic should enlarge and invigorate its conceptions by the use of imagination: . . . neither is sufficient alone" ("Understanding and Imagination" 4). Coleridge spent most of his adult life working on a defense of logic, in part to undermine the idea that induction was the only path to scientific knowledge. Rather, he recognized, to make progress with strict induction would take several lifetimes. It was therefore pragmatic to begin scientific knowledge with a hypothesis, and this meant that imagination could have a substantial, if regulated, role within science (Merrison 174–75). That he understood logic to concern "not what we understand nor how much, but simply how we understand" (Coleridge, *Logic* 45), and defined it as "the art and science of discoursing conclusively" (22) indicated that neither had a monopoly over it.

The traditional view of the imagination as articulated by the likes of Frye, Bloom, and Engell assumes that imagination reached its developmental peak in Romantic literature, and it wrongly predicates this teleology on the assumption of a split between the two cultures of science and literature before any such split

solidified.[40] Even today, Gerald Holton notes that many of the binaries associated with scientific innovation (reason/imagination, subjective/objective, logical/empirical) do not lend themselves to describing the human activity of scientific work (xiv), and neither do they capture Romantic art or science. George Rousseau pointed out decades ago that the Romantic imagination was a physiological imagination, and thus it could be medically described (*NA* 86–91),[41] a view that should have put to bed these reifications of a split. Frye based his understanding of the educated imagination on what we know now to be a false dichotomy between literature and science: "Literature belongs to the world man constructs, not the world he sees" (27). Davy grouped both poetry and philosophy under "science": the former was "the science of feeling"; the latter, the "science of ideas" (Notebook HD/21/b, page 10).[42] He cultivated a reputation for genius by showing himself attuned to the sublime powers of nature and swanning around with his manipulations of the voltaic battery (Golinski, *Experimental Self* 53).

Any binary opposition between feelings and ideas or art and science were undercut by the fact that feeling, as in Kant's notion of beauty, could lead to ideas like purposiveness without purpose, central to both nineteenth-century biology and aesthetics.[43] As Coleridge insisted in a letter to Thelwall, "I seldom feel without thinking or think without feeling" (*CL* 1: 279). The scientific appreciation of nature required an aesthetic sensibility, and the study of metamorphosis in living things enabled "art and nature to lose their separate identities" (Wellmann 122). Dalia Nassar puts it thusly: "The experience of beauty expands our concept of nature insofar as it points to analogies between our creative capacities . . . and the natural world" (63). Kant, of course, suggests that constructs themselves enable meaningful seeing, and Blake insists that infinity was possible if only one cleansed one's doors of perception. Frye goes on to emphasize, "The world of literature is human in shape . . . , where the primary realities are not atoms or electrons but bodies, and the primary forces not energy or gravitation but love and death and passion and pity" (28). Yet Percy Shelley hypothesizes that the forces of attraction and repulsion that hold matter together are love. Bloom falsely pits imagination against nature: "The mind, searching for what would suffice, encountered an icy remoteness, but dared to affirm the triumph of its imaginings over the solitude and vacancy of inadvertent nature" (*Ringers* 90). However, organicism left little that could be considered inadvertent about Romantic living nature, and many scientists linked life with purposiveness, a way of looking at forms and appearances of nature as if they were designed. Purposiveness provided biologists with the idea of a plan without having to specify one (R. Richards, *Conception* 71).[44] Baldly put, the science of the time made it difficult to tar nature with the brush

of alienation, and the best scientists, like Goethe's tender empiricists,[45] felt nature's manifold interconnections.

Romantic conceptions of embodied minds, moreover, refused anything like two cultures of art and science,[46] emphasizing instead a relationality between mind and world that regarded such triumph as hollow. Kant thought consciousness needed objects. Hence, Percy Shelley, in his poem "The Triumph of Life," depicts intellectual history as being inexorably chained both to the car of life and to the brain: "A vision on my brain was rolled." And, hence, Coleridge's primary imagination is tied to perception, and I will show how his physiological understanding of imagination made it difficult to separate the material from the idea, a point Coleridge underscored when he writes, "Thought is the participle past of Thing" (*N* 3587).[47] His point is that they are not fundamentally different entities: what separates materiality and idea is the passage of time. An embodied mind, furthermore, learns from the body, as its emotions color our deliberations and enable us to make choices.[48] Indeed, Kant in his 1786 "What Is Orientation in Thinking," makes clear that the conscious mind is necessarily embodied, as he there begins his treatment of thought with the need to feel a difference between his right and left hands because the body provides thought the orientation it needs to get going.

In his magisterial *The Creative Imagination*, James Engell also tends to celebrate creativity as a necessary good and to locate its apotheosis within Romantic literature.[49] And yet, because of the constant traffic between literature and science, the creative imagination would not be confined to the arts.[50] So, for example, as Ursula Klein has documented, well into the nineteenth century the laboratory was both an artisanal and scientific space, either in the home or university, for implementing chemical operations.[51] Novalis, trained in the Freiberg Mining Academy in mineralogy and geology, claimed the laboratory to be a site of creativity and wrote in his *Notebook of Medical-Natural Scientific Studies* that "natural genius belongs in experimenting, that is to say, that wondrous ability to capture the sense of nature—and to act in her spirit. The true observer is an artist—he divines the significant (*Notes* 219). Novalis shows that the fault lines between art and science were much more fluid than the scholarship tends to admit. Even artists had interest in laboratories. In 1801, Coleridge hoped to entice Wordsworth and William Calvert to study chemistry together, and this prompted Coleridge to write to Davy, asking him to send "directions for a convenient little Laboratory" to facilitate their study (*CL* 2: 378).[52]

This fluid boundary between art and science was underscored by the fact that *Naturphilosophie*, the search for an overall theory of the self-organizing powers of

nature, was "normal science" (Beiser, "Kant and *Naturphilosophie*" 10), one that called upon the power of the imagination to animate what otherwise might remain particular and detached facts.[53] This group included such diverse writers as Friedrich Schlegel, Johann Wolfgang von Goethe, Joseph Schelling, Georg Hegel, Immanuel Kant, Lorenz Oken, Karl von Baer, and Hans Christian Orsted.[54] When critics of *Naturphilosophie* dismissed it as bogus because of what they saw as a metaphysical quest for unity, they not only underestimated its concern with observation and experiment, but they also neglected arguments about the solipsism of merely personal experience.[55] These critics also underestimated the nature philosopher's fascination with the formal power of paradox to gesture toward life, as in the idea of purposiveness without purpose. Nonetheless, as Modiano, Beiser, and Robert Richards have shown, this movement made key contributions to science—such as Orsted's discovery of electromagnetism,[56] Johann Wilhelm Ritter's discovery of ultraviolet light, and von Baer's making of embryology into a science—and its emphasis on the need for a methodology to explain nature as an organic unity made possible these contributions. For our purposes here, the dismissal of *Naturphilosophie* as a science not only makes it possible to overlook the force science has over Romanticism, but it also has made it more difficult to see why poetry and science did not have to be at odds. Both considered beauty to bespeak the intelligibility of the world. Jon Klancher has recently shown how much entanglement and intermediation there was between the arts and the sciences through institutions like the Royal Institution, which were devoted to both, and he illustrates how the one helped form the other. Davy, we recall, commented that "there is no absolute utility in poetry; but it gives pleasure, refines and exalts the mind. Philosophic pursuits [chief among them chemistry] have likewise a noble and independent use of this kind" (*Consolations* 9: 360).[57] We should not forget that chemistry could be considered an art or skill.

Such Romantic traffic between the arts and sciences has been screened by the recounting of famous moments as when Blake urged that that "God us Keep / From Single Visions & Newton's sleep" (E722)[58] or when Keats accuses Newton of having unwoven with cold philosophy the poetry of the rainbow. Of course, Blake turned to Newton to better articulate what the triumph of imaginative vision would look like, and Newton was not necessarily the enemy (Ault, *Visionary Physics*). Not only does *Lamia* then go on to warn of the dangers of enchantment, but also Keats knows that science is not merely cold philosophy. Stuart Sperry has demonstrated how the poet's two courses in chemistry helped make the world more enchanting and simultaneously more intelligible, while Richard Holmes has suggested how Romantic science enhances wonder rather than encouraging its demise.[59] Indeed,

when Humboldt argues that "the plant kingdom impresses our imagination through a constant immensity" (161), he at once insists that the sublime is what provides the scientific observer with her attachment to nature so it can be studied and then has to worry that such immensity does not devolve aesthetically into "tediousness": "One should avoid the impression of tediousness that any enumeration of individual forms must invariably elicit" (163). When scientific discovery is caricatured as a slavish method that rotely follows rules, it might look like a stable, efficient, reproducible process, but it is also thereby emptied of creativity, denied the imagination, and demonized.[60] In his important study of the scientific imagination, Gerald Holton argues that success requires the mobilizing of different kinds of resources: theoretical frameworks, experimental activity, gathering data, and interpretation through concepts (xxix). Friedrich Steinle adds, "Experiments aren't simply found; they are made," and "experimental results are not attained but negotiated" (*Exploratory Experiments* 302, 306).[61] No rote method can capture these nuances, just as no rote method yields artistic creativity (our current blind faith in innovation notwithstanding). He also underscores the value of unintended interactions or applications, which of course must be recognized (xxxvii), and I submit such recognition begins as feeling.

To the traditional view of imagination, a group of historicist critics led by Jerome McGann responded that the Romantic imagination was ideologically evasive and escapist, but they too indirectly assume a split between poetry and science that was not firmly in place.[62] Such a split was licensed by a fundamental misunderstanding of the relation between the immaterial and material, and the role of Romantic science in adjudicating the two.[63] One reason why the line between the immaterial and material was so vexed was the fact that, in Romanticism, scientists had to come to terms with both what they thought were new forms of matter like electromagnetism along with an overwhelming sense of the diversity of the living world.[64] For one, what does materiality mean when it includes "imponderable" matter, their category for matter without mass, which included entities like heat/caloric, light, and ether? For another, Dalton posited that the atoms of one element differ from the atoms of another element, thus linking it with difference. With regard to the diversity of living things, Buffon insists, "There are really only individuals in nature, and genera, orders and classes exist only in our imagination" (*Oeuvres* 1: 54). If taxonomic categories belong to imagination, then it is charged with finding the natural order in the living world.

Taken together, then, Romantic matter explodes with difference, and difference undermines any necessary opposition between materiality and figuration that would allow figuration empire over difference, an opposition already undercut by

Kant's injunction to think of things as forms or appearances.[65] I suggest here that logocentrism is predicated on a mattercentrism, which is false, and this means language has been given too much credit for its awareness of difference. Kant argues that, "whereas matter is a plurality of things that cannot itself supply a determinate unity for its combination, . . . an idea is an absolute unity of presentation" (*CJ* 377).

Another reason why Romantic matter and spirit won't be conveniently sorted was the pervasive dissatisfaction with materialist and mechanistic accounts of living matter: even though Kant thought that mechanism was essential for something to be a science, he recognized that biology needed a concept of purposiveness if it were to try to account for the self-organizing powers of life. If conventional views assume the imagination to be immaterial, historicist views insist that the immaterial amounts to an ideological evasiveness, but this is to ignore both how difference made it more difficult to generalize about materiality and how Romantic science appropriated the idealizing logic of "as if." Historicist critics thus err when they presume that to make the imagination material is to understand its transcendence ideologically, and thus true criticism is tasked with bankrupting the imagination by showing transcendence to be a lie. Such a split was further underwritten by an idea of objectivity that was also not, as Lorraine Daston and Peter Galison argue, in place even within science. "To be objective," they write, "is to aspire to knowledge that bears no trace of the knower—knowledge unmarked by prejudice or skill, fantasy or judgment, wishing or striving" (17). But Romantic science was tied to the ability to feel.

I argue the imagination and its insistence upon phenomenality was an important precursor to scientific objectivity because it demanded recognition of the difference between an appearance, which was inseparable from subjectivity, and reality. Nonetheless, for scientific objectivity to become what Daston and Galison refer to as an "epistemic virtue," a conflation of epistemology and ethics that enables the creation of a scientific self that seemingly does not have one (39–40), one first had to confront the degree to which it was possible to get outside the self and its ability to perceive.[66] One also has to imagine an epistemology that does not rely upon the exile of subjectivity to sanitize itself. As I show, the imagination played a key role in this history. On the one hand, only a visionary imagination could abstract rules and laws out of empirical particularities, and to do that particularities had to be seen and felt in terms of meaningful patterns.[67] On the other hand, one had to recognize that the creative freedom and sensibility of imagination were not absolute goods, and thus it was imperative to impose limits upon it.[68] Hence, the Romantics oft deploy a disciplined, rational, feeling imagination

against a wild, excessively feeling, spontaneous one, in the process operationalizing what discipline looks like as well as setting the benchmarks for the subject's education or *Bildung*, so it could be measured.[69] The stakes here were enormous. After insisting that "no one, certainly can regulate the imagination of another," Thomas Beddoes prescribes anatomical, physiological, and natural historical knowledge as a prophylactic to the evils of masturbation because these are "incapable of raising improper emotions" (1: 49–53). Certainly, his injunction that boys should learn the difference between the oviparous and viviparous classes provided a much-needed cold shower, as did his insistence they be instructed in the history of diseases.[70] Physician Thomas Arnold warned that, when the imagination was too active, it would be led by the "slightest associations," even the most "dissimilar" and incongruous ones, and if unchecked would lead to insanity (2: 431).[71]

Romantic artists and scientists thereby not only put the *Bildung* in the *Einbildungskraft* (imagination)—we should pause over the fact that the wild imagination makes *Bildung* possible—but they also took advantage of the traffic between domains that can be so conducive to creativity.[72] Without first asking how any proposition was possible and without having rules for judging possibility, one could not have knowledge but only fantasy. Yet proving something to be impossible was also much more difficult than to prove an instance of it to be false. Objectivity itself is further in part about the feeling of asceticism, and, in this view, objectivity demands the exchange of one set of emotions—sympathy—for another—the pleasures of self-denial (P. White 825–26).[73] The Romantic history of the imagination shows how and why this asceticism came to be, even as it, in closing the gaps between feeling and objectivity, allows Romanticism full participation in the history of science. Furthermore, by acknowledging a link between objectivity and feelings, we enlarge what the practices of science look and feel like. If the more emotional imagination worked by spontaneous associations that could not be controlled but were spontaneously generative, its more rational counter-spirit could evaluate those associations.[74]

What historicists dismiss as ideological transcendence could actually be far more complicated: it could take the form of a Kantian a priori, that which is before experience but necessary for knowledge like concepts of causality or even of time and space; or it could take the form of a postulate or hypothesis; or it could frame differences as local differences, ultimately subsumable under an absolute. Orsted's ability to see the differences in the powers and kinds of matter in terms of related forms, for instance, was key to helping him to discover electromagnetism. Whewell, furthermore, stipulated that speculative theories "for any other purpose than that of comparison with observation are frivolous and useless exer-

cises of ingenuity" (Address xxii). The mathematician Poincaré later cautioned that although the mind's laws are "imposed on our science, they are not imposed on nature" (xviii). Together, these examples show that what Kant called the transcendental could be very useful for both science and art.

WHAT'S WRONG WITH HISTORICIST AND IDEOLOGICAL APPROACHES TO IMAGINATION?

Proponents of ideological approaches to the imagination often insist that the imagination is tied to a certain kind of personage—the white bourgeois subject—and therefore smacks of elitism. Rather than bankrupting the imagination in advance in this way, I highlight both an epistemological imagination that has the potential to work democratically to discipline individuals so that reason and imagination can cooperate, and the need to examine what the Romantic imagination accomplishes, instead of rejecting it dogmatically.

There are three main problems with the historicist critique of imagination and the understanding of materiality that historicism relies upon. First, the science of the time offered many ways in which to think about the imagination in materialist terms, and so the Romantic imagination will stand in for neither transcendence nor ideological evasion. Historicism makes the options starker than they actually are when it understands materiality as a corrective. Despite its political charge of French radicalism and atheism, materiality gave the imagination necessary intelligibility: how it worked and had effects on the world was the concern of scientists and writers alike. When Wordsworth worries about the repair and restoration of his imagination in *The Prelude*, he has to figure out how that repair is to take place, which in turn demands an account of what the imagination is, how it works, and what caused it to break down.[75] Simply put, one had to have a way of explaining how the imagination could encounter the things of this world and what that encounter meant. The fact that physiology took on epistemology made it absolutely central to the imagination's intelligibility. That physiology and epistemology could be linked at all suggests how complicated the mind's connection to the body could be, as well as how an embodied imagination could nonetheless provide transcendent rules for knowing.

Second, the opposition between the material and immaterial was neither as drastic as we take it to be, nor were its stakes such that materialism could be a corrective to idealism.[76] Kantian modesty about knowledge of things made claims of materiality overtly speculative. Once one could take for granted that matter needed to be imagined, Kant recognized the need for two modes of reasoning: the constitutive, based on secure a priori concepts, and the regulative use of it, which

relies on an imaginative "as if" supposition because it is not secure. When historicist critics link imagination to ideology, they ignore the skepticism scientists had about both ontology and constitutive reasoning. A number of scientists recognized that very few phenomena could be constitutively grounded, but science as procedure could hold out the hope for such a future grounding. Kant insists, "The concept of a thing as in itself a natural purpose is not a constitutive concept either of understanding or of reason. But it can still be a regulative concept for reflective judgment, allowing us to use a remote analogy with our own causality in terms of purposes generally, to guide our investigation of organized objects and to meditate regarding their supreme basis" (*CJ* 376).[77] Nonetheless, the regulative use of reason merely stipulated that if a concept were necessary for the science to exist, the concept could be used so long as it was not framed constitutively.[78] Because living things required some notion of purposiveness in order to explain them, purposiveness could provide at least a regulative basis for biology.[79] While "regulative" explanations recognized the limits of imagination, constitutive ones risked immodesty and error, not to mention dogmatism.

At a practical level, because scientists could not afford to preclude spiritual concerns even within science (they could not risk atheism) and because concepts like imponderable matter—a matter that was not measurable—helped to equivocate between new forms of matter like radiant or electromagnetic matter and known matter, the boundary between materiality and immateriality was porous. This was another reason why materiality could not immunize ideology.[80] Kant, we recall, insisted that concepts allowed things to come into being. He would later in his *Opus Postumum* define physics as "a system of perceptions from the forces of matter which affect the senses, insofar as they modify the subject according to a principle of the possibility of experience (outer as well as inner)" (127). Insofar as the creative imagination was understood as that which allows us to have the judgment that comes with seeing the universal in the particular (Warnock 83), ideas will not easily be severed from things. That is Coleridge's point when he insists that "not the Ground (material subjecta) but the relations constitute all individuality" (*CN* 4356). Within science, Kantian judgment helped foster the discovery of new natural laws and the interconnectedness of all life by encouraging the finding of the universal within the particular.[81] Hence Cuvier argued that the essence of vitality[82] would only be reached through the rigorous comparison of particular with general forms within comparative anatomy (1: xxii). With regard to the imagination, Cuvier stipulated that one first had to distinguish between what it was possible as a physiologist to know—he argued that the "effects of habit and attention" could be known only by the metaphysician (2: 115)—but the physiologist could attend to the "order

of corporeal motions which correspond exactly to those sensations and combination of ideas" (ibid.). In sum, he argued that "the imagination will produce physical effects on the body, which seem to be a repercussion of the influence which the physical changes of the body have on them" (2: 115–16). Crucially, the imagination can be studied through its physical effects, but any correspondence between those effects and imagination is bracketed by "seems."[83]

Together, then, science and literature shared an interest in phenomenology, in part because claims of ontology were beyond what it was possible to know, but also because thinking in terms of appearances helped to foster comparisons and a sense of felt interconnectedness, not to mention a sense of the difference between careful practiced observations and imperfect first notions. Perhaps the feeling of belonging opened the subject up to imaginative improvisation, which De Quincey referred to as being "forced into the consciousness of creative energies" (5: 307), and thus generativeness could temporarily compensate for the limits of what could be known to be known.[84] Hence, Goethe warns against seeing experiments in terms of isolated facts, instead urging the systematic placement of phenomena next to another ("Experiment as Mediator" 21–22) along with the active finding of the patterns between them (the *Urphänomen*) while being careful not to be misled by the confirmation bias entailed in one's own hypotheses.[85] Seeing each stage of growth of the plant as one of its forms enabled him to observe fastidiously how leaves developed into other parts of the plant. The life sciences, too, were limited to appearances and forms, but could discipline those appearances under laws. Kant defined thinking itself as "uniting representations in consciousness" (*PMN* 305).

Representation—what Cuvier refers to as a "correspond[ence]," and not an identity—further insisted upon a gap between the object and its appearance, which was crucial for self-reflection and the ability to improve one's powers of observation.[86] Not only were feelings an indispensable part of experience, but also at least in French the word for "experience," *expérience*, was also the word for "experiment."[87] In the Argument to *All Religions Are One*, Blake alludes to the slide between the two when he insists, "As the true method of knowledge is experiment the true faculty of knowing must be the faculty which experiences" (plate 3). He would go on to name "poetic genius" as the faculty of experience and knowing. Key to scientific explanation, then, was the ability to account for how the object could be encountered by human experience, and this meant that the narrative of the encounter, the feltness, acquired the power of a limited fact.[88] If the object could be encountered by experience, moreover, one could conceive of either logical consequences ensuing from it or invent an experiment that might

reveal something about it.[89] As Wordsworth and Coleridge put it in their 1802 "Preface to the Lyrical Ballads," "We have no knowledge, that is, no general principles drawn from the contemplation of particular facts, but what has been built up by pleasure, and exists in us by pleasure alone. The Man of Science, the Chemist and Mathematician, whatever difficulties and disgusts they may have had to struggle with, know and feel this" (258).

Daston submits that "between about 1780 and 1820 . . . facts hardened, the imagination ran riot, and act and science diverged in their aims" ("Fear" 81). Daston and Galison insist that a split took place in Romanticism in how the imagination was understood, as writers increasingly speak of the imagination as being "creative," "inventive," and "holistic," while scientists move away from such ideas toward seeing science as exclusively concerned with the understanding of facts and with the avoidance of large-scale systematic claims (246). By contrast, I argue that such a split was more rhetorical (performative) than actual (constative), notwithstanding Wordsworth's polemical antithesis between poetry and "matter of fact, or science" ("Preface," 1800 ed., 254).[90] Instead of fixing fields, my approach further asks that we consider the kinds of work that these declared border raids accomplish. The short answer is they evidence creativity. Goethe denies that facts can be separated from theory: "The highest is to understand that all fact is really theory" (cited in Seamon and Zajonc 4). Leigh Hunt further supports the idea that any such notion of a widening gap between art and science was performative, writing, "As feeling is the earliest teacher, and perception the only final proof of things most demonstrable by science, so the remotest imaginations of the poets may often be found to have the closest connexion with matter of fact" (4).[91] And in 1833 William Whewell lamented that "it has of late been common to assert that facts alone are valuable in science," consequently, a tension between theory and fact has made "men's observations and speculations useless and fruitless" (xx). While his lament might be construed as evidence for Daston and Galison's claims of a split, Whewell is resisting the elevation of facts and claiming that the value placed on them is an assertion. Dalton worried about numbers of "alleged" chemical facts (*New System* 2: appendix), which warns about the dangers of the standalone power of facts.

To the extent that Romantic scientific objects had to explain how they could be encountered, "fact" included how the object was experienced,[92] and the value of including how it was experienced helped to surround this fact with modesty and contingency, which, in turn, made it continuously subject to scientific methods. John Tresch has shown the importance Romantic scientists gave to "feeling around in the invisible" as they discovered the properties of electromagnetism

(40), and he conclusively shows feeling was often the road to fact, but facts then are still tied to the subjective experience of them. After noting that natural philosophy "does not consist in a sterile accumulation of facts," Humboldt, despite his mounting footnotes, insisted that "it is the privilege of the curious and active mind of humanity to occasionally drift out of the present and into the darkness of prehistory" (257). Hazlitt insists that "without being grounded in facts & feelings, we shall end as we began in ignorance" ("Understanding and Imagination" 5), and feelings here are also a ground. He continues, speaking of the slave trade, "Those evils that inflame the imagination & make the heart sick, ought not to leave the head cool" (6–7). Hazlitt urges that feelings should prompt decisive action. In a larger view, because any border between science and art mobilizes other binaries, such as logic and creativity, method and spontaneity, fact and fiction, feeling and reason, its citation could energize.

Romantic facts would further not immunize the imagination from error because they were difficult to separate from how they were to be operationalized or understood, and this meant that they "conform[ed] neither to positivistic views nor towards the radical contingencies of postmodernism" (Holland, "Facts" 4). Instead, "the Romantic fact seems most comfortable poised on the threshold between theoretical system and event" (ibid.).[93] Hence Cuvier lamented that physiology "possess[ed] no demonstrated principle, whence the particular facts might be deduced as consequences, the whole science consists as yet in the series of these facts only" (1: xxii). And Coleridge opined that nature "supplies" us with "a motley chaos of facts," which "conscious choice will perfect into knowledge" (*Logic* 8). Faraday, moreover, commented that "he is the wisest philosopher who holds his theory with some doubt—who is able to proportion his judgment and confidence to the value of the evidence set before him before taking a fact for a fact & a supposition for a supposition" ("Speculations"), and he often noted his general suspicion of what others took as facts, insisting that "the general fact sought to be proved" ("Annotated Offprints" F/3/E, page 73). Orsted called "genius" the ability "to create a true theory from all the facts which they have found in nature by means of their profound understanding" ("Chemistry of the Nineteenth Century" 123).[94] In this view, facts entail profound understanding that makes them coherent.[95] He both thinks that facts have a kind of purposiveness and believes that experiment operationalizes fact, once again undermining their ability to ground. Because the event requires a system in which to make sense, the Romantic fact was inextricable from the contexts that called for its citation. Whewell put it best: "It is only through some view or other of the connexion or relation of facts, that we know what circumstances we ought to notice and record" (Address

xx). His Kantian understanding of an idea as that which gave form to the sensations (Yeo 12) further vexed the relation of fact to objectivity.[96]

In fact, insofar as the experience of matter mattered more than its ontology, sensibility, or the ability to feel, took on a truth-bearing weight that Victorian objectivity has obscured.[97] While things-in-and-of-themselves might be beyond our knowledge, the ability to experience things was not, and thus things had to be framed in such a way that our experience of them would be possible. Without this ability to experience the scientific object, it was at best difficult to instrumentalize it into an experiment because one had to suss out how to operationalize it. Thus, the possibility of experiencing objects became the fault line between an imagination that was disciplined and an imagination bent pathologically on fantasy. This is why atoms were dismissed as fantasy: they could not be experienced. Surprisingly, then, feeling and science thus were not necessarily enemies. Jessica Riskin has argued that science of the Enlightenment demanded sensibility, which in turn stipulated modesty. The way to know something to be true was to be in touch with it, not to coldly objectify it as being wholly separate from the perceiving subject.[98] Wordsworth thus demanded that readers attend to the "passion [within] the forms of nature themselves" (*Prelude*, 1850 ed., book 13, page 347). Such feeling was especially sought after, given Romantic science's interest in unity: the particular feeling had the potential to put one in contact with the universal. The necessary counterweight to such feeling was skepticism about the knowability of ontology that was signaled by a gap between the feeling and the thing. The gap between feeling and the thing meant that one could talk about forms and appearances of the material rather than materiality itself. Instead of materiality being able to rescue artists and scientists from idealism or transcendence, then, the transcendental was precisely the opposite of ideology: it was a way of thinking about the limits of one's knowledge of the material. In their rush to ideology, historicist and deconstructive readings of the imagination have missed the mark. An added boon: this gap left space for the self to occupy.

My insistence upon the importance of phenomenology to Romanticism means that Romantic art could function neither as a mirror to the world (mimesis) nor as a lamp (pure expression), since only the appearance could be mirrored and because the expressions of form ran the danger of simply skipping over the thing. Art and science were furthermore united in their mutual insistence upon form and representation as potentially powerful means of knowing, but that power stemmed from the ability to correct one's assumptions when necessary.[99] Thinking of natural objects as representations not only invited such correction but also crucially provided a vantage point from which to see the possibility of error. Be-

cause there were effects that chemistry at the time could not clearly attribute either to matter or the powers governing it, for instance, Faraday refers to "heat, [and] electricity" as "phenomena" so that he can be careful not to attribute it to the one or the other ("Lectures on Chemistry" 111).

Hence, the third reason why a split between science and literature was not in place: a culture of sensibility that not only declared feelings to have a crucial relationship to even scientific knowledge but also insisted upon a modesty surrounding what it was possible to know.[100] Imagination enabled an idea to become registered as a felt impression. As Mary Warnock puts it, "Imagination, then has two functions which go together; to shape by means of an inner power, and to allow us to feel" (78).[101] For Ampère, *tatônnement*, or "tactile testing," was crucial to his epistemic project. He thought that knowledge arose from "resistances between the will, the muscles, and external objects" (Tresch 39). Ampère was part of a larger cultural recognition of the importance of the viewer's senses, habits, and memory in creating perception. In this view, poetic vision and scientific scrutiny need not be at odds.[102] Goethe's scientific writings therefore go hand in hand with his poetry about plants.[103]

The Romantic fascination with phenomenality further helps explain Romanticism and its double consciousness, not to mention its faith in imagination once one understands its limits. In *Dark Interpreter*, Tilottama Rajan illustrates how Romanticism participates in contradictory aesthetic postures that seem dialectically to idealize and doubt the power of art. To the extent that phenomenality holds the world in suspension, it defers endorsement and imposes modesty upon claims even as it questions the given so that change becomes possible. This deferral of commitment need not be an evasiveness; moreover, it can be quite useful for science, especially when science can turn to a never-ending verificationalism that is always able to revise the given.[104] If idealization meant that the absolute was eventually attainable, and perhaps most readily so within aesthetic intuition, then skepticism insisted on the gaps between nature and freedom.[105] In the Romantic period, not only did feeling have some power to verify, but also, because skepticism and idealism were constant options, emotions necessarily fluctuated, shaping cognition. In Victorianism, objectivity would consolidate powers of verificationalism and, with the exception of physicist John Tyndall, largely leave the imagination behind.[106] Objectivity's rise entailed the imagination's descent. Tyndall reminded his readers that Newton's "passage from a falling apple to a falling moon" was in fact a leap of imagination (6).

Let me elaborate on what I mean by the ability of science always to revise the given, especially since this capacity for revision is indebted to imagination. Both

Romantic science and current science avail themselves of what I call "empirical futurity": an empiricism that promises to negate itself based on future findings or technologies that would allow new theories and things to come into being, sometimes clustered around similar objects.[107] One way strict empiricism negates itself is through a scientific object that is more like a metaphor.[108] Science has little use for objects that do not adapt to changing technologies and the "advance" of knowledge, and Kantian modesty about things accepts changes of appearances without necessarily canceling out their status as the same objects. For example, Evelyn Fox Keller has written eloquently about the fact that "genes" function like a metaphor since, in the history of their scientific use, they refer to something that is an actor or something acted upon or some combination of both. Similarly, "plasticity" can refer to a necessary process of neural development, the modest capacity of the brain to repair itself, and the making and breaking of neural connections (Rose and Rose 90). The floating definition means the object in question, the nerves, can be adapted to changing ontological speculations. This imaginative work is screened by scientific objectivity, a verificationalism that stretches into the future, even as it claims a rigorous empiricism by conflating a commitment to empiricism with empiricism itself—even more so for sciences that claim insight into futurity, the ability to make predictions.[109] Within neuroscience, empirical futurity can manifest itself as a commitment to some future mechanism that will explain consciousness.

Far from ideology, then, the Romantic imagination thus becomes a way of either venturing or forestalling commitment: Davy writes, "May we not venture to imagine, that the visible and tangible world, with which we are acquainted by our sensations, bears the same relations to the divine and infinite Intelligence, that our organs bear to our mind" (*Consolations* 9: 380)—and "venture" here not only insists upon provisionality, but it also is limited to claims of relationality.[110] Davy argues that mind might be to brain as divine intelligence is to tangibility. It also helps explain the double consciousness within Romantic science, which, on the one hand, sought to find unity in the world and which, on the other hand, recognized the obstreperousness of certain particularities to yield to larger patterns, along with the totalizing potential of those larger patterns to swallow up everything in their path.[111] Unity could unwittingly impose domination. Coleridge's strategy for dealing with this problem is multeity in unity, whereas Blake's is an endlessly proliferating series of allegories. To the extent that the Romantic imagination is the context through which these writers saw and felt the world, it is the vehicle through which their idealism and skepticism, not to mention apprehension of unity and difference, took root.

Insofar as science has an open commitment to a form of materiality that may be available only in the future, it must rely upon imagination, and the problem now becomes how to discipline imagination to make it a reliable tool of epistemology. Here, reliability eschews stability and instead becomes about including the possibility of self-correction. Seen thusly, the imagination allows science to become about a process of trial and error, even as science models itself on the organic processes of the human mind, and error itself is transformed into a tool that is a necessary step on the way to knowledge (Cowles 644).[112] The problem of epistemology, then, in Romanticism is not often framed in terms of getting rid of imagination but rather how to get it to work with reason. Even when excoriated, the imagination functioned as a useful enemy. Although Kant labeled imagination "blind," he made it central to the unifying of the manifold of presentations and to the unity of the self that enabled thought itself. It was therefore central to the apprehension of both the subject and object. And despite the fact that the phrenologist Spurzheim warned that the "faculty of imagining . . . is a power which gives a great exaltation to the feelings," he insisted that "the feelings are under controul of the judgment" (n.p.).

We witness the truth value of feeling and imagination within science in Humphry Davy's 1802 "A Discourse Introductory to a Course of Lectures on Chemistry," when he insists, "The food of the imagination is supplied by the sense, and all ideas existing in the human mind are representations of parts of nature accurately delineated by memory, or tinged with the glow of passion, and formed into new combinations by fancy. In this view researches concerning the phaenomena of corpuscular action may be said to be almost natural to the mind, and to arise out of its instinctive feelings" (2: 324–25). Davy argues that the food of imagination comes from the senses, and he thereby seeks to connect mental representations with nature. Yet note his turn to "phaenomena" when thinking about corpuscular action, which frames them as an appearance and not ontology. When he has them "tinged with the glow of passion," he thus insists on how feelings enable attention to said phenomena in a way reminiscent of the German *Gefühl*, or inner tactile feel for ideas, that was central to knowledge in German Romanticism.[113] He then insists that "the study of nature, therefore, in her various operations must be always more or less connected with the love of the beautiful and the sublime; and in consequence of the extent and indefiniteness of the views it presents to us, it is eminently calculated to gratify and keep alive the more powerful passions and ambitions of the soul" (2: 325). Because nature is bracketed by phenomenality, it is proximate to the aesthetic and therefore reveals the scientist's powers of judgment. One outcome of this: experiment in the Romantic period was not neces-

sarily driven by a hypothesis but could be tasked with simply becoming familiar with all related phenomena and their extensions (Tresch 39), and this meant that, just in the same way materiality could not cure idealism, experiment could further imaginative speculation rather than put an end to it.

Davy concludes his chemical lecture, however, by noting that experiment "may destroy diseases of the imagination, owing to too deep a sensibility" ("Discourse Introductory" 2: 326). Experiment starts to function here as the counter to excessive sensibility, the cause of disease, and this suggests that knowledge has its roots in sensibility and its excesses or the limits of *Gefühl*. This, in turn, reminds us that experiment was about the testing of experience about the relation between experience and knowledge (Henderson 155). Since feelings were an inescapable part of that experience, the key was to understand how much attention one needed to give to them. Note, however, that not attending to them is not an option.

Mary Shelley had read Davy's 1802 Royal Institution lecture in October 1816.[114] Indeed, when she comments that "in a scientific pursuit there is continual food for discovery and wonder" (*Frankenstein* 33), she likely tips her hat to Davy. When she foregrounds the feelings that drive Victor Frankenstein—the variety of which "bore [him] onwards, like a hurricane, in the first enthusiasm of success" (36)—she reminds us of the legacy of sensibility upon science but argues that Victor has become so dangerously attuned to his own ego that his sensibility becomes a form of absolute selfishness, an irony Shelley underscores when Victor interprets the monster's threat to be with him on his wedding night as a threat against himself, despite the growing pile of dead bodies surrounding him. When he refuses to attend to the "loathing from [his] occupation" (37), working as he does alongside the worms of death, and when he "tortures the living animal to animate the lifeless clay" (36), Shelley warns that Frankenstein's sensibility has been perverted. Sensibility in fact gave electrical science an ethics: much work on electricity within medicine was driven by a search for new cures to such diseases as rheumatism. Victor, however, thinks about electricity only as a way of buttressing his own growing ego, how his creatures will worship him. Sensibility thus begins to require something like objectivity to guard against such extremes. When Victor declares himself the winner of his own pity party over Justine—"the tortures of the accused did not equal mine" (64)—Mary Shelley indirectly protests enough is enough.

Thomas Hankins provides another lens for thinking about the rise of phenomenality within the science of the time: "The materialist philosophers of the eighteenth century made matter active by giving it the properties of life. In essence, they distributed the soul throughout matter in order to get rid of it" (127). Hankins suggests a synthesis of materiality and idealism, and—I will show how—as con-

cepts of the material shifted under dynamism, they defied any easy opposition between idealism and materiality that underwrites many of the critical assumptions about imagination. Kant's argument about matter stipulates that we must grapple with what enables human beings to encounter it, and thus the forces of attraction and repulsion within matter are what enable us to sense it. With this growing recognition of the importance of phenomenality came a stress on the unifying powers of the imagination, which enabled seeing symbolically in terms of the universal within each particular. Coleridge mistakenly thought that the German for imagination, *Einbildungskraft*, began with the word "one," and he liked the fact that it brought together different phenomena into one image (Warnock 92).

My argument, then, insists that the imagination mattered and was not merely delusion or a literary phenomenon, and that science helped explain why it mattered. Ever since Francis Bacon showed how the imagination helped to produce idols of the mind, there was scientific distrust about the imagination.[115] Because he thought that the human understanding was too easily moved by things that strike it, he accused the imagination of not only being too easily filled but also of imputing a similarity to the objects it gathered that was not there (Bacon 1: 47).[116] Romantic writers even within the sciences helped to overcome this distrust in two ways: first, by thinking through the ways in which one has to imagine an idea before one can prove it; therefore, imagination, despite its problems, becomes an unavoidable part of discovery. Second, they insisted, despite knowing that imagination sometimes worked unconsciously or subconsciously, that its fruits could be harnessed in concert with reason and not against it.[117] Paradoxically, the imagination could help discover what was possible along with the limits to possibility.[118] Coleridge defined "hypothesis" as "the placing of one known fact under others as their ground or foundation." He went on to stipulate that "not the fact itself but only its position in a certain relation is imagined" (*N* 3587). In this view, imagination could conform to reason when it was restricted to considering possible relations between facts and observations. The fact that its workings were often below the level of consciousness—again Kant calls the imagination "blind"—meant that it was prudent to adopt an essential modesty toward its fruits. Nonetheless, Davy recalls that Bacon was able to find value in the errors of alchemy: in "searching for an imaginary treasure, [they] fertilized the soil" (*Consolations* 9: 356).

When William Blake pronounced, "What is now proved was once, only imagin'd" (E36), he insists both that one has to imagine an idea before proving it and that science is more than mere proving.[119] Although science today underscores verification, how did the candidates for verification come into being?

Blake's apprenticeship to James Basire, the official engraver of the Royal Society, helped him to recognize that. And although critics are fond of quoting Keats's comparison of the imagination to Adam's dream to show the seductive powers of imagination—"he awoke and found it true"—Keats's pronoun is "he," and he immediately qualifies this with "I have never yet been able to perceive how any thing can be known for truth by consequitive [*sic*] reasoning—and yet it must be—." The poet's "must" wagers a speculative truth of imagination that binds consecutives into a unity that Keats cannot perceive. Still rarer is quotation of this passage's end, when Keats extolls a "complex Mind—one that is imaginative and at the same time careful of its fruits" (*Letters* 1: 185–86).[120]

Wordsworth in book 13 of *The Prelude* likewise comments:

> I had been taught to reverence a Power
> That is the visible quality and shape
> And image of right reason; that matures
> Her processes by steadfast laws; gives birth
> To no impatient or fallacious hopes,
> No heat of passion or excessive zeal,
> No vain conceits; provokes to no quick turns
> Of self-applauding intellect; but trains
> To meekness, and exalts by humble faith;
> Holds up before the mind intoxicate
> With present objects, and the busy dance
> Of things that pass away, a temperate show
> Of objects that endure. (1850 ed., page 336, lines 20–32)

The poet insists upon objects as appearances, and he warns against the tendency to intoxicate our minds with "present objects." Against those "present objects," he foregrounds "a temperate show / Of objects that endure." Whether the objects are present objects or enduring objects, Wordsworth insists upon "show," or appearance, and thus the only way to make sense of objects is not only to understand what truly endures but also to question even physicality itself as a necessary form of endurance. If phenomenality brackets objects, it also brackets the perceiving imagination, and hence his metonymies for imagination—power, quality, shape, image, and reason—insist upon mediations. Since both the subject and the object are likewise mediated, the one can encounter the other. Instead of a knowledge that is contingent upon a power differential between subjects and objects, then, Wordsworth stipulates an imagination that is the inescapable source of the mind's presentations, and he insists that the imagination is needed to help sort out

the enduring from the ephemeral. Although he here stipulates the many things that can go wrong with the imagination—fallacious hopes, excessive zeal, a "self-applauding" intellect—Wordsworth insists that so long as the imagination can be an image of right reason, it will lead us to "steadfast laws." Awareness of the subject's emotions enables them to be cancelled out if necessary.

As Wordsworth suggests, the ability to image things as not necessarily physically present was useful to both literature and science insofar as imagination could suggest both ways of improving the world and methods for testing things whose physical contours were unknown. Within Romantic science, one name for this was "hypothesis," and I show how hypothesis and speculation became necessary but provisional ways for moving forward in physiology and neurology. Thomas Hankins puts it thusly: "Experimental physiology in the eighteenth century became phenomenalistic" (115). To the extent that experiment aligned with phenomenality, even it could promote an idealism that was not the antithesis of, but rather underwrote, materiality. The upshot here is that vitalism encouraged descriptions that were about appearances, not ontology, and thus the imagination could make important and necessary contributions to the framing of the phenomenality of matter itself insofar as the meaning of the appearance was open to debate. Baldly put, claims of vitalist ontology were beyond what was possible for science to know; nonetheless, as Denise Gigante remarks, "The hermeneutic field constituting Romantic life science addressed the complexity of the organism in a way that twenty-first century biologists have once more begun to do," but that is because it acknowledged the role of interpretation (29).[121] Molecular biology has had to come to terms with the fact that the appearance of life and the appearance of genetic information are not the same thing (Morange 16), and thus life has returned as a scientific goal.[122] The idea of life in the deep sea as well as on other planets has challenged its deepest assumptions, such as the degree to which life must be carbon based.

The story I will tell about the Romantic imagination is one infused by science. The direct consequences of these connections are to redefine the imagination as an epistemological faculty that produces ideas and makes possible comparisons, scientific as well as poetic ones.[123] The imagination generates hypotheses that in order to become scientific must somehow be confirmed. Alan Richardson has shown that the mind-brain problem in the Romantic period matters. But science demonstrated that regulating the imagination was as natural as indulging in it as a matter of escape. From a medical point of view, the regulation of diet and behavior was thought to help stem the excesses of imagination. And if physiology showed the imagination could exacerbate the symptoms of certain diseases, the

challenge was to show how it could aid in healing. Cuvier worried about how to weed out imposters like Mesmer, writing, "It must be confessed, that it is extremely difficult . . . to distinguish between the effect of the imagination of the person subjected to the experiment, from the physical effects produced by the operation, and the problem is frequently complicated" (2: 122), but the panel of scientists overcame this problem by inventing the blind experiment. Scientific ideas further underscored the difficulty of the separation of the imagination from the world, and understanding these contexts helps make it clear that the fears of the imagination's delusions are more ours than theirs, especially since Romantic thinkers put protocols in place to insulate the imagination from delusion. Today, psychologists recognize that even children understand imaginary friends to be imaginary, and I therefore suggest Romantic critics have overestimated the imagination's ability to foster delusion by neither paying enough attention to the role it played in bracketing claims within science nor to the protocols invented that enabled it to work with reason, and even if its spontaneity could not be controlled, judgment could be applied to its fruits.[124]

Simply put, in reminding us of the links between imagination and science, I restore the imagination's role as an engine of epistemology, once its limits were understood, and also help explain why the period could not avoid imagination. Even when Kant and Faraday consider atomism as a symptom of an overactive imagination, they did not reject it. How is that possible? As I argue, they framed the problem in terms of the amount of freedom given to the imagination, and, as a result, they sought to come up with principles that would contain that freedom without destroying its generative, spontaneous, and creative powers. The Romantics understood that science advances neither by facts alone nor by brutal reductionism alone. Instead, scientific advancement occurs through disciplined uses of imagination that allow forms to suggest laws.

Permit me to offer a few words about what is not included here and why. In using the term "scientist," I risk anachronism because I seek to remind readers of Coleridge's role in shaping the term.[125] At the 1833 meeting of the British Association for the Advancement of Science, William Whewell coined the term "scientist," after Coleridge insisted that these "men" stop calling themselves "natural philosophers."[126] "There was [then] no clear distinction between philosophy and science, and no such thing as a pure empirical science limited only to observation and experiment" (Beiser, "Kant and *Naturphilosophie*" 10). In 1834, Whewell, in a review of Mary Somerville's work, used the term "scientist" for the first time in print, perhaps because "man of science" would have been inappropriate. James Secord cautions that Whewell actually thought of her as better than a scientist: as a phi-

losopher (106). Although he considered "natural philosopher" to be "too wide and too lofty" (Yeo 110), "scientist" was to Coleridge, by contrast, also a bit of a demotion, a turn to the empirical and away from the rationalism and "inner sense" embraced by natural philosophy (*BL* 1: 250–52). My use of the term "scientist," then, highlights Romanticism's recognition of the need for such a term, along with its wariness of naming of a kind of self that negated certain forms of subjectivity and eventually with them feelings, the very bases of our points of contact between the self and the object. Furthermore, since "what constitutes a 'science' or a legitimate system of knowledge depends . . . on the criteria specific to each historical period" (M. Kim 4), "Romantic scientist" captures the historical specificity of this particular kind of practitioner. Despite the fact that "scientist" would later indicate specialization, Whewell uses it in admiration of Somerville's unification of branches of physical knowledge. I also do not have much new to say about botany and geology, and here books by Theresa Kelley, Alan Bewell, Noah Heringman, and Ralph O'Connor fill this gap.[127]

CHAPTERS AND SCOPE

Chapters thus explore the ways in which Romantic writers and scientists argue for the value of imagination in scientific practice, and the ways those arguments should challenge assumptions about what the imagination can and cannot do. Ranging widely across the work of such diverse Romantic scientists as Davy, Faraday, Boscovich, Priestley, Kant, Mary Somerville, Goethe, Haller, Humboldt, Orsted, Swedenborg, Blumenbach, Buffon, Saumarez, Erasmus Darwin, Smellie, and Von Baer, this book considers how these authors impacted ideas of imagination in such key Romantic works as *Prometheus Unbound*, *The Four Zoas*, *The Biographia Literaria*, and *Frankenstein*. And, since the range of practices that fall under the banner of Romantic science was wider than we tend to remember, it was no wonder that imagination had such a charged role. Torn between a *Naturphilosophie* that was drawn to metaphysics even when it was most experimental and a Baconian experimental program that also recognized the value of concepts, Romantic science struggled to find peace with a working method that could make coherent these disparate practices, and this study concentrates on how the imagination helped to operationalize various methods. It often did so by bracketing imaginative speculations as fodder for future confirmation, but the forms for that confirmation were multiple and not just experiment.[128]

Because the Romantic imagination is bound up in debates about matter, I begin with chemistry and physics and consider how scientists like Priestley, Davy, Kant, and Faraday, among others, reject atomism as a delusion of imagination

and yet nonetheless turn to imagination in their considerations of dynamic matter. Indeed, Orsted credited Kant for having "liberated" physics "from the atomistic system, which, though of speculative origin, was made the basis of experimental physics" ("Introduction to General Physics" 305). Chapter 1 thus pursues the Kantian argument that human understanding cannot get to things-in-and-of-themselves, and, as a result, matter was necessarily imagined. In the process, I show how imagination was instrumentalized to perform the work of science, and Kant and others did so by considering what limits to the imagination's freedoms were necessary. Percy Shelley not only thought about matter in terms of dynamic force, but he also considered love to be a force of attraction within the universe. As a key to a dynamic materiality, attractive force made it possible to unite imagination and matter. And as Davy had realized, Volta's battery enabled the breaking of this attractive force by splitting compounds into their individual elements.

I turn in chapter 2 to think about why Blake in *The Four Zoas*, on the one hand, fervently believed in a visionary imagination and, at the same time, localized this imagination in the brain and nerves. How did Romantic neurology facilitate his insistent embodiment of imagination, and how could such reductionism not come at the cost of a meaningful self? I contrast physicalism, which usually eliminates autonomy and context, with Blake's proliferating mythology and developing nervous system to address this question. And, given how often the word "delusion" appears in the poem, why does Blake risk tarring imagination with the delusions of dreams, and what are the circumstances under which the imagination can yield knowledge? I also consider the ways in which neurology of the time could foster an idea of an emergent self.

Chapter 3 considers how the science of physiology shapes Coleridge's famous theory of imagination. While critics have shown how the *Biographia* was his attempt to prove his unlearned genius, I show how he claims both genius and science. Since genius and imagination worked unconsciously, they resisted being subject to rules. Because physiology had to correlate phenomena with natural laws even when the possibility of such correlations seemed doubtful, it provided models for how to substantiate laws and principles. Of crucial importance was the ability to determine the difference between speculations that had no possibility of actuality and speculations that did. Because physiology of the time tried to explain life in terms of vitalism, the theory that life was irreducible to chemical and physical principles, the imagination and vitalism could both profit from being explained in terms of models that either demanded the possibility of actuality for fear that imagination would usurp reason, or by models that bracketed such claims as appearances necessary for human experience. Physiologists took for granted that the

imagination was part of how minds work, and therefore they sought to construct systems that would allow imagination to work with reason. Because Coleridge considered mechanism to deny human agency, he turns to imagination to postulate a will, but only for the purposes of maintaining human morality. Once again method reigns in imagination.[129] Through his famous definition of the imagination, he operationalizes cooperation between it and reason through the tools of physiology, a partnership that entailed a more modest and rational yet more creative imagination than has sometimes been offered.

Chapter 4 explores the place of imagination in obstetrics and embryology, and then considers how these debates shape Mary Shelley's *Frankenstein*. I here begin with Erasmus Darwin's emphasis on the imagination's ability to produce analogies, which raises the problem of how one knows a useful analogy from a false one. With so much unknown in both fields, analogy was a crucial tactic. One strategy was to consider the difference between a surface similarity and a deeper one. Within obstetrics, men-midwives were trying to determine what practices should become standard, and this meant that the imagination functioned to stipulate possible methods so that one might evaluate them. Within embryology, scientists had to figure out how to prove or disprove theories of epigenesis or preformationism, which raised the frame problem. If the same empirical data could be used in service of either theory, how might one justify the theoretical frame one chose? If, under preformationism, God and mothers' imaginations could be blamed for evil and monstrosity, what we now call birth defects, epigenesis stipulated the source of the problem to be the process of development. For Mary Shelley, the process responsible for monsters was not biological but rather cultural, and it was Victor Frankenstein's fantasy that his imagination was fully autonomous that led development astray.

I close this introduction by commenting upon the irony that at the moment when science is giving serious attention to the imagination's cognitive powers, Romantic critics are diminishing its influence by localizing it to particular figures.[130] Philosopher Shaun Nichols highlights a robust scientific research program devoted to understanding the cognitive powers of the "propositional imagination," which is important because it tells us what is possible and not possible. In *The Rational Imagination*, Ruth Byrne considers how logical our counterfactual imaginations truly are: when people imagine alternatives to reality, those alternatives it turns out are conditioned by reality. Psychologist Dan Gilbert credits imagination for our ability to anticipate our futures, and he warns that, because our imaginations work so quickly, we are not skeptical enough of its fruits.[131] On the one hand, this current scientific optimism surrounding the imagination and

its capacity for enhancing knowledge does not take seriously enough what could go wrong with it. On the other hand, such optimism might usefully challenge the marginalization of the imagination within the humanities, including the localization of it within Romantic criticism, and even within some accounts of science, and it is in the spirit of this challenge that this book has been written. By neglecting the imagination's role in epistemology of the time, Romanticists have done nothing less than give up the store.

CHAPTER 1

Imagining Dynamic Matter

Percy Shelley, Prometheus Unbound, *and the Chemistry and Physics of Matter*

Men and women of science like Roger Boscovich, Humphry Davy, Joseph Priestley, Mary Somerville, and Michael Faraday, and philosophers like Kant and Schelling helped Romantic writers to understand matter not in terms of Newtonian corpuscles or atoms (often referred to as atomism) but rather in terms of dynamic forces.[1] If matter is force instead of corpuscles, one has a greater sense that the world is one in which change and motion are not only possible but inevitable, since, as the hypothesized essence of matter, change and motion are the being of the world. Moreover, where atomism relied on direct material contact between particles, dynamism presumed that space was filled with fields of force. Thus, everything interacted with everything else, thereby demanding an ecological understanding of one's actions because there were now necessarily multiple centers of activity and influence. Although the things in our life may not change because our knowledge of them changes, the matter of the world becomes dynamic rather than solid and impenetrable, and our sense of how we act and the meaning of the impact of our actions will change accordingly. I argue that Percy Shelley's figures in *Prometheus Unbound* refer to and mimic the dynamism of matter, making them not so much about a theory of language, as they are often claimed to be.[2] What has not been adequately understood is that his figures proffer ways of thinking about both the forces of matter and their consequences for human action, mental states, and the imagination.

At the center of the Romantic turn to dynamism was the imagination. Changing the understanding of matter from corpuscle to force demands two acts of imagination. First, in accord with the Kantian modesty that abandons claims to know what the essence of matter is, we accept that our thinking about matter must

be imaginative if we are to think about it at all. Michael Faraday, for example, not only used the imagination as a way of indicating such modesty, but he also thereby generated endless objects to be further studied and systematically experimented upon.[3] If he and other scientists thus labeled atomistic theories of matter pure imagination, they also recognized that any ontological claim about matter risked letting the imagination run wild.[4] Thus, second, seeing the world in terms of forces entails seeing it as different than it looks, perceiving it as force in motion with dispersed effects, as opposed to its appearance as solidity at rest. This insistence of phenomenality over ontology makes the matter of the world astonishing, not false, because matter's status as appearance grants its freedom from the normative force of fact perception even as it registers normative perception as constraint (Terada, *LA* 39).[5] Orsted and others took great consolation from the fact that "all the different forces of nature can be traced back to those two fundamental forces [attraction and repulsion]" (197).

Such astonishment orients the subject's imagination toward the things of this world rather than away from them: Coleridge's phrase for this is "wonder-promising matter" (*BL* 1: 134). Coleridge elsewhere elaborates, "We cannot conceive even of the merest thing, a stone for instance, as simply and exclusively being, as absolutely passive and actionless. Were it but the act of reflecting the light by which it is seen, or as the sum of the acts of attraction by which its particles cohere, and the stone is" (*Logic* 21). Such astonishment further proffers the thinkability of things but does not mistake thinkability for knowability.[6] Situated at the gap between human thought and knowledge, Romantic matter is suffused with an irony that makes any uses to which its essence is put ultimately strategic even when it does not look so.[7] That is, because ideas of matter were driven by the need to make matter intelligible, Romantic materiality made no necessary claims to ontology.[8] I am therefore interested in the ways one could think about matter but not know it, making matter necessarily imagined and the imagination about the relation of thinking to knowing.[9]

Within *Prometheus Unbound*, Shelley's articulations of the workings of the world and the forces that drive it are (a) depictions of a way science thought about matter and not an imagining that turns its back on reality and (b) part of the Kantian modesty about what imagining matter means. Scientific modesty is underwritten by a superhuman ambition that would demand "the corporate development of prosthetic insight" (Picciotto 20), by which Picciotto means the collective labors of a scientific community. The Romantic imagination of matter was thus far from an escapist idealism. For one, materiality could not be a form of self-evidence, like a slap in the face, but rather had at its core a debate about what counts as

materiality.[10] Was materiality to be found in extension or in the dynamic forces of attraction and repulsion that produced extension? Romantic physicists and chemists struggled with how to reconcile electromagnetism with Newtonian concepts of matter, and it was not until James Clerk Maxwell that the new fundamental entity known as charge was added. Because it is not clear whether field, charge, and energy conform to concepts of matter or move beyond them, in physics, physicalism has replaced materialism, since this term captures physical laws in ways that materialism may not. In the name of history, then, historicists have framed the imagination within a debate about its alleged immateriality and escapism that could not be more unhistorical. For another, since it was unclear whether thought necessitated another kind of matter than ordinary matter, the traffic between imagination and matter helped to define the boundaries of both.[11]

Romantic reflexiveness about materiality serves as a useful warning to the proponents of the new materialism of today, those Deleuzian- or Spinozist-inspired critics who are now enamored with matter because it is understood as vital.[12] I will show the new materialism's Romantic past. From Shelley's perspective, the new materialists have lost the skepticism that comes with the need to think about matter as necessarily imagined. If materiality is entwined with imagination, then it can neither rescue the imagination from the charge of fecklessness nor serve as a counterweight to imagination. Instead, the force of Romantic materiality lies within the worlds it makes epistemologically available and open to question. The concept of vital matter, furthermore, participates in a category mistake: as Henry Staten argues, "Life is a possibility of materiality, not as a potential that it is 'normal' for materiality to bring forth, but a vastly improbable possibility, by far the exception rather than the rule" (34–35). Finally, I worry about such born-again materialism, arising out of the ashes of its exhaustion of our having limited it to constraint. What underwrites this faith in matter to now do everything we once thought it could not do?

My larger aim here is to develop a rationale for materialist possibility, one made possible by the turn to dynamism. Because atomism requires direct contact between corpuscles—there can be no action at a distance—possibility is not real (Harré 14). The turn to force makes possibility itself possible because action no longer requires direct contact.[13] I must also ask why materialism is so often coupled with determinism. The material is frequently understood simultaneously as a proxy for reality and as that which conditions it: the idea of solidity and impenetrability makes matter seem irrefutable. Seeing matter as dynamic force frustrates the work of materiality to condition and determine, and, because the various forms that matter might take were imagined as appearances, matter was left with no

necessary determining qualities since it was always changing appearances and since its forces might always be overcome by a greater force. In Shelley's view, matter as solidity was a form of casuistry. Žižek argues that "no historical Necessity pre-exists the contingent process of its actualization" (212), and this would encompass matter itself under dynamism. In fact, the apprehension of matter as dynamic fueled skepticism about the status quo even as it solidified the imagination's hold on matter. Because matter is in process rather than finished, materiality cannot condition but instead functions as contingency.

ROMANTIC DYNAMISM

Developments in chemistry, electricity, and magnetism, especially the discovery of polarity, led Romantic physicists and chemists to make a concerted effort to reject Newtonian mechanical corpuscles and Descartes's *Res Extensa*, and instead to begin thinking of matter in terms of the unified dynamism of force.[14] Polarity suggested the forces within matter. Dynamism was attractive, moreover, because it facilitated an escape from the determinism of Newtonian physics and from the dualism of Cartesianism, not to mention the epistemological difficulties in postulating imperceptible corpuscles.[15] The imperceptibility of atoms made the imaginative practices associated with it irrelevant (they called it delusive).[16] In fact, Davy, Kant, Priestley, and Faraday all linked corpuscularity or atoms with a deluded imagination since there was nothing about them that could be seen: Davy warned that "ultimate particles or atoms are mere creations of the imagination" (*Consolations* 9: 363).[17] Scottish scientist Mary Somerville explained how Thomas Young's 1801 double slit experiment demonstrated that light had to be a wave, thereby further undermining the theory of corpuscularity since light as wave could not be made up of atoms. Waves, after all, needed a medium of propagation (Dear, *Intelligibility* 120). Somerville concluded that "Newton and most of his immediate successors [had] imagined light to be a material substance" (161). They argued that a properly disciplined imagination, by contrast, would recognize matter to be composed of forces, not bodies. A corpuscular theory assumes both "local motion and a particulate matter as the basis for explaining the physical world" (J. Edwards 96). Quite simply, the Romantics thought of matter not as dead or inert impenetrability but in terms of active forces, and they did so to allow imagination and matter to interact through forces that were not just passive.[18] Kant himself praised "dynamical natural philosophy" on the grounds that it does not regard material bodies as "machines, that is, mere tools of external moving forces" (cited in Modiano 142). Hence Blake has Tharmas insist, "I am like an Atom/A Nothing left in darkness" (*FZ* N1 E302: 61), and in *Urizen* the void is referred to as the negation

of "globes of attraction" (N3 E71: 36).[19] Forces, moreover, facilitated the ultimate unity of matter because it brought together such disparate phenomena as electricity, light, magnetism, and matter.[20] While Kant's definition of matter in terms of the powers of attraction and repulsion led Goethe to develop a concept of the fundamental polarity of all beings (R. Richards, *Conception* 429), Orsted credited the dynamical theory of matter with leading him to the discovery of electromagnetism (Gower 340–43; Stauffer 37–38).

Why did Romantic scientists so often call upon the imagination in order to rethink matter as essentially dynamic? Under dynamism, matter is or has superadded within it an interplay between attractive and repulsive forces (J. Edwards 99). Two questions ensue. What counts as human action, since the forces of matter act? And if matter as force becomes a genuine source of causality, why could not mental activity have force and causality?[21] In the cases of Humphry Davy and Michael Faraday, because the idea of merely mechanical forces did not sit well with their theology, dynamism offered the possibility of God's active management of the things of this world.[22] Davy, in fact, considered time in terms of the process of chemical reactions (*Consolations*, dialogue 6). In a larger view, theories of matter inevitably impact human action, because they form the backdrop against which human action becomes knowable. Hannah Arendt adds that "change would be impossible if we could not mentally remove ourselves from where we are physically located and imagine that things might well be different from what they actually are" (5). I underscore that the necessary imagination of matter primed the pump to think about the nature of human action and to see that action in relation to the forces of the world.[23]

Of course, the trajectory from corpuscularism to dynamism that I have outlined above is not in actuality so tidy. Newton, who is sometimes taken to be a dynamist, for example, subscribes to a corpuscular theory of matter and, in fact, grants hardness, impenetrability, and inertia the status of primary qualities (J. Edwards 101). But this does not prevent him from also supporting passive forces inhering in nature. The tradition of British dynamism, then, emphasized Newton's claims about force, even though he treats force hypothetically in queries 18–24 of the *Optics*, notwithstanding the fact that he considers the forces inhering in matter to be passive, and despite the fact that there are vestiges of corpuscularism within his notion of ether (J. Edwards 102–03).[24] Newton ends the *Principia* invoking a "most subtle spirit which pervades and lies hid in all gross bodies; by the force and action of which spirit the particles of bodies attract one another at near distances" (2: 547). Corpuscular definitions lost ground in the Enlightenment in no small part because of the empiricist objections of Hume and Berkeley. While

the term "dynamism," moreover, usually embraces a rejection of corpuscularism, dynamism stresses the role of forces either in their own right or as constitutive of matter insofar as attraction and repulsion are what give matter the appearance of extension. An added complication: mechanism stresses the role of matter to which forces may or may not be superadded. So, as in the case of Kant, one can be a dynamist and a mechanist at the same time.

Qualifications aside, Romantic thinkers embraced a theory of matter that emphasized the activeness of force within matter so that human beings might engage with it and so that the dynamism of matter could flout determinism.[25] Gone are Newton's merely passive forces. Active forces within matter made it more unpredictable. No longer conveniently idealist and escapist, the Romantic imagination would now have to be understood as the entity that both intuits change and frames change itself as a continuous part of the universe. Since "every change presupposes the identity of the thing being changed" (Pollok, "Kant's Critical Concepts" 571), human change would now have to be gauged against the constant forces of nature. I also must acknowledge that while Romantic writers did sometimes find the inevitability and ubiquity of worldly change therapeutic to their idealism, the need to measure human action against the actions of the physical world helped to contain that idealism. Percy Shelley, for instance, considers love to be one of the basic forces in the universe, akin to gravity and magnetism. The key now would be how to understand human agency in relation to the ongoing dynamic changes within nature, for how was one to know the difference? The cultural fascination with electricity and magnetism led to electrical and magnetic attractive theories of matter. Now that matter as force was no longer merely or simply mechanical, how to think about it? How did the activeness of matter impact human action? Matter itself would demand reimagination, which in turn set the stage for the rethinking of what counted as social change.[26]

Possible within a Romantic view of nature is an ontological equality that allows contact and mutual relations between forces of nature and imagination. Steven Shaviro puts it thusly: "If the environment enters into the nature of each thing, then no single being—not even the human subject, and not even God—can claim priority over any other" (282). Hence, Romantic writers understand subject and object as versions of being, while relationality becomes an incipient unity. Mutuality further allows free will to be maintained so long as one chooses which forces surrounding oneself control the self.

Briefly, my large claim here is that in the Romantic period there was no necessary tension between the imagination and matter because, as Kant, Priestley, and Faraday argued, the corpuscular theory of matter was imagined, and irrespon-

sibly so.[27] To wit, Schelling calls atomism "a lazy style of philosophizing" (189) because it relies upon impenetrability as its only ground (189), and impenetrability can be had only "by setting absolute bounds to the imagination" (169), a setting of bounds that is actually "deadening" to it (169). "It becomes so easy, once the imagination has been deadened, to conceive of something absolutely impenetrable," Schelling warns.[28] Dynamism, by contrast, led to the responsible (and for Schelling enlivening) imagination of matter in terms of a continuous change that is understood as an assumption to be proven.[29] I will show how the dynamic theory of matter made it into an event to be synthesized by imagination, and thus matter was the embodiment of the forces of change. Furthermore, "force" worked as an intermediary between matter and consciousness, and it could do so because thought was considered to be motion: Coleridge, for instance, traced the etymology of mind to a German word indicating "vibratory yet progressive motion" (*CN* 1: 378).[30] Motion, of course, was the external sign of force, and this way mind could act upon matter. Such reciprocity, indeed, was underscored in the German word for "imagination," *Einbildungskraft*, because *Kraft* means "force." No need then to choose mind over matter or vice versa because mind is matter and imagination has force, giving both the possibility of interaction and unity.

REIMAGINING MATTER

In the Romantic period, matter is increasingly understood in terms of dynamism—force and affinity—and what this means is that change and motion become inevitable. The problem now becomes how to measure human change against the forces of the world.[31] That said, the dots connecting the dynamism of matter with human agency changes from scientist to scientist, writer to writer. My goal, however, is to show how this relation makes it unnecessary to assume that matter is necessarily intransigent to human will, and that some, like Kant, understood matter a form of action of attractive and repulsive forces that could be made consonant with human action.[32] Because the concept of force itself in the eighteenth century was ambiguous, referring either to the momentum of a moving body or its energy, force threatened to make matter essentially active (Hankins 282). Hardness, extension, impenetrability, by contrast, all made matter seem intractable and resistant to change. The acceptance of forces as the ground for the properties of matter we can experience necessarily entails a rejection of hardness and the like as foundational qualities of matter (J. Edwards 110). Despite the fact that they consider atomism a delusion of the imagination when the atom was more than a concept, Boscovich, Davy, Faraday, Kant, and Priestley all insist upon the imagination as necessary to apprehend matter correctly.[33] Not only then must the imagination

be capable of self-correcting in ways that historicist critics have not acknowledged, but also the imagination now has material consequence in the form of shaping how one encounters matter and thereby counters the forces of nature, along with how one thinks of human action.

By showing how scientists turned to the imagination to think about Romantic matter, I aim to rethink the imagination's relation to materiality. Two consequences ensue. One, the imagination can no longer be simply seen as fecklessly immaterial because it is enmeshed in the very thinking of matter itself. Two, since Romantic materiality is necessarily imagined, the one cannot become a cure for the other, and this should call into question the ways in which "materiality" often functions within Romantic literary criticism as a badge of honor.[34] Within science, a disciplined imagination was thought to prevent delusion, and, in fact, many scientists considered the imagination as a way of bracketing claims as not yet proven. When he claimed that "every scientific statement must remain tentative forever" (153), Karl Popper invested science with the work of imagination.[35] Schelling said it better: "The real concept of matter itself first proceeds from the synthesis of those forces by the imagination" (187–88). For Schelling, "real" means not merely logical, and his point is that most theories of materiality have put the cart before the horse. That is, they have put matter before the imagination that made its possibility possible.[36]

Leibniz, as it were, got the ball actively rolling: he understood inertia as a principle of effort, which must be the outcome of an inherent force or activity (Jammer 161). He thus transformed the meaning of "force" "from a mechanical mode of operation" to "a principle of almost vitalistic activity" (158), an activity inherent in the moving body (161) that kept the universe from running down and coming to a halt (Hankins 282) and simultaneously made force the essence of matter. In his *Essay de Dynamique* (1692), he argued that since movement did not truly exist because it is a transient thing and space was only a relational concept, force was really "the cause of motion," and force is the thing that "truly exists" (131).[37] Leibniz explained that "active force contains a certain activity or entelechy and is midway between the faculty of acting and the action itself" (from his *Monadology*, cited in Jammer 160). In *Theodicy* (288), Leibniz claimed that spontaneity is the "body and basis" of freedom, and that monads—simple substances—are the spontaneous causes of their own states. The Leibniz scholar Donald Rutherford suggests, "Although agent spontaneity may be a requirement of freedom, the possibility of agent spontaneity presupposes the truth of monadic spontaneity."[38] For Leibniz, the spontaneous dynamism of matter, then, grounds freedom itself, for the two must exist in a preestablished harmony. Not only does the dynamism

of matter allow it to be read in concert with human action, not against it, but also that dynamism helps define human action in such terms that matter and human effort are potentially in harmony.

Building on Leibniz but dismissing his need for actual living forces since mechanism could fully account for his concept of force, philosopher and physicist Roger Joseph Boscovich[39] in 1758 defined matter as being "composed of perfectly indivisible, non-extended, discrete points" (67), and all these mathematical points, practically devoid of all properties beyond force, exert forces on each other.[40] He defined force as a propensity to approach or recession, a propensity to be measured by the acceleration produced (Jammer 177). Boscovich had significant influence on both Davy and Faraday, among others (Knight, *Atoms and Elements* 14). Because impenetrability and extension are the "spatial expression of forces" (Jammer 178), forces are thus more fundamental than matter in the Cartesian sense, and, consequently, matter has no extension but is made up of focal points of attractive and repulsive forces (J. Edwards 103). Matter thereby became calculable and visualizable, and the visualizability of what was in fact invisible was key to intelligibility. Hence one reason why imagination was both important and dangerous to Romantic science. These geometrical points by virtue of their spatial relations became "a system of powers or tendencies to motion" (Levere, *Affinity* 13). Boscovich further shifted emphasis from issues of substance to issues of relationality. What mattered in his system was the relation of one atomic point to another, making possible an ecological understanding of matter. Each particle of the universe has a dynamic relation to every other particle (Jammer 174).

Boscovich's fascination with the forces of matter further helps undermine any necessary tension between imagination and matter. In his preface to his *A Theory of Natural Philosophy*, Boscovich praised the superiority of geometry to algebra because while the latter "does not assist the imagination in the way," the former does (8). Note that he frames the imagination *not* as something to be feared: it is something to be assisted. We can further unpack the significance of his invocation of the imagination if we attend to his description of how geometry assists the imagination:

> The whole matter reduces to this. In a straight line of indefinite length, which is called the axis, a fixed point is taken; & segments of a straight line cut off from this point represent the distances. A curve is drawn following the general direction of this straight line, & winding about it, so as to cut it in several places. Then perpendiculars that are drawn from the ends of the segments to meet the curve represent the forces;[41] these forces are greater or less, according as such

> perpendiculars are greater or less; & they pass from attractive forces to repulsive, and vice versa, whenever their perpendiculars change their direction, as the curve passes from one side of the axis of indefinite length to the other side of it. (*Theory of Natural Philosophy* 8)

The imagination allows Boscovich to conceptualize matter in terms of discrete points, themselves driven by forces represented through geometrical curves. The curves, and the perpendiculars drawn from the curves, enable the collapse of repulsion and attraction to "a single, continuous, action-at-a-distance curve of attractive and repulsive accelerations" (Schofield, *Mechanism* 236). At a certain distance from the point, Boscovich argues, attraction becomes repulsion. Geometry, therefore, assists the imagination by modeling the workings of matter.

In a larger view, the imagination allows Boscovich to envision one conclusion from geometry leading to another—emplotting its workings in deductive steps—and in this way, he thought he had done Newton one better because he was able to reduce all of nature to a single axiom, the fact that matter was composed of discrete points. He submitted, "I have deduced the whole of it by a straightforward & perfectly rigorous chain of reasoning" (10).[42] An additional boon from his theory of forces was his ability to turn to repulsive forces to explain sensation: "My repulsive force . . . is bound to excite in the nerves of those organs the motions which, according to the usual idea, are excited by impenetrability and contact" (56). Here, impenetrability is nothing more than the work of repulsion. Reasoning provides access to central truths about matter; and therefore imagination, insofar as it is disciplined by geometry, must remain a key means for the possible understanding of matter. Boscovich thus makes matter and imagination mutually reinforcing, since imagination is what allows matter to be encountered and understood. And yet this mutuality must remain a struggle because it is contingent upon the successful disciplining of the imagination by geometrical reasoning.

With Kant, the imagination was all the more necessary to apprehend matter. Against what he called a fabrication of the world "from the full and the empty in accordance with mere fantasy" (*MFNS* IV, 524) (aus dem Vollen und Leeren eine Welt blos nach der Phantasie zu zimmern [*MAN* 83]),[43] Immanuel Kant redefines matter in terms of dynamic forces, and he does so because movement is what makes matter visible to us, and because he thinks that the empirical givens of impenetrability and extension are really the products of the forces of attraction and repulsion.[44] Although Kant revered Newton, he could not abide by his atoms and voids because he thought both were empty concepts. Since for Kant the office of the imagination is the spontaneous synthesis of the presentations that un-

fold in time and space, there is no getting around it. His distinction between *Phantasie* and *Einbildungskraft*, however, rests on the degree of freedom given to the imagination.[45]

My interest here is in how Kant is able to deploy fantasy (*Phantasie*/imagination) to delegitimate the rival corpuscular/atomic theory of matter and then simultaneously to use *Einbildungskraft*, the imagination, to argue for an empirical concept of matter as the moveable. Of course, Kant himself in 1755 subscribed to a corpuscular theory of matter and thus not only knew firsthand the power of *Phantasie* but recognized how easily *Phantasie* might slide into *Einbildungskraft*:[46] unlike the former, the latter term insists upon the educability of imagination with the word *Bildung*. In his *Philosophy of Material Nature* (1786), Kant jokes that Swiss mathematician Johann Lambert's theory of matter would place logic at its center because for him the presence of something real carries with it resistance by virtue of the principle of contradiction (*PMN* 2: 498). He therefore replaces Lambert's principle of contradiction with repulsive forces because those forces help him to "understand" how the principle of contradiction arose in the first place (2: 498). If *Phantasie* allows Kant to delegitimate versions of matter like atomism or Boscovichean points by insisting that they are based on mere hypotheses, a disciplined imagination, whose discipline makes itself educable (*Bildung*) and which knows the difference between fantasy and reality, also knows that movement alone is what allows us both to perceive matter and make it empirical. Splitting the imagination into disciplined and undisciplined forms enabled Kant to argue that corpuscularity was mere fantasy, while dynamic forces were the result of careful imaginative education. "But who claims to comprehend the possibility of fundamental forces?" he asks (2: 525). These forces "can only be assumed, if they inevitably belong to a concept concerning which there can be proved that it is a fundamental concept not further derivable from any other" (2: 525). Kant's choice of "assumed" makes clear that his dynamic theory of matter is just a theory, albeit functioning as if it were a foundational fact, but one that importantly lends matter a phenomenality that makes it available to human experience.

The dynamic forces that constitute matter are thus necessarily imagined or assumed, and Kant shows the discipline of his imagination by, on the one hand, refusing to assume that these forces have more than conceptual status and by, on the other hand, recognizing that our access to things must remain conceptual. He continues, "He must not . . . presume to assume either of them as actual because the authorization to set up a hypothesis irremissibly requires the possibility of what is assumed to be entirely certain" (*MFNS* II, 525). Claims of knowing actuality are presumption; moreover, what is to be counted as certain must be first

shown to be possible. The imagination is not so much the problem for Kant: the problem is that it is often given the freedom to elide conceptual with actual things or, in this case, count on something as certain before it has even been proven encounterable by human perception.

Kant does recognize that corpuscularity carries with it all the advantages of mathematic physics. He insists, the advantage of a "merely mathematical physics . . . [is that it] allows the possibility of shapes as well as of the empty intermediate spaces [to] be proved with mathematical evidence" (*MFNS* IV, 525). But this advantage brings with it two damaging liabilities: "It must lay at its foundation [the] empty concept of absolute impenetrability, and secondly must give up all the proper forces of matter" (ibid.). Kant adds, "It is afterwards required to make explications and must then allow the imagination more freedom in the field of philosophy—and indeed allow this freedom as a rightful claim—than can be consistent with the caution of philosophy" (ibid.). The original German reads: "Nachdem es das Bedürfnis zu Erklären erfodert, der Einbildungskraft im felde der Philosophie mehr Freiheit, ja gar rechtmässigen anspruch verstatten muss, als sich wol mit der Behutsamkeit der ressteren zusammen reimen lasst" (*MAN* 85). Note that Kant does not use *Phantasie* as he did with atomism, but he uses *Einbildungskraft* because it insists upon education. Since *reimen* means "rhyme," a more fitting translation might be freedom in tune with the caution of philosophy, making any freedom worth having at the same time necessarily disciplined by philosophical caution and a sensuous experience that is enhanced, not expunged, by philosophy, the means to *Bildung*.

Kant insists, by contrast, that corpuscular theory of matter allows more "freedom of imagination than philosophy demands" despite the fact that he must admit that, with his own theory based on forces, "all means are wanting for the construction of this concept and for presenting as possible in intuition what we thought universally" (4: 525). The point to underscore here is that the problem is not a necessary antagonism between imagination and philosophy: excess of freedom is the problem. It would seem that the lack of a means for constructing a concept is better than an empty concept, but this choice makes the imagination perilously close to *Phantasie*.

On what grounds, then, does Kant associate excessive imaginative freedom with the former theory of matter, and how does he insulate his own theory from that very charge, especially given that he cannot use force to fulfill his very own criteria for pure, a priori knowledge?[47] Kant admits that the laws of "fundamental forces . . . we are not able to determine a priori, [and] still less are we able to reliably indicate a manifold of such forces sufficient for explicating the specific vari-

ety of matter" (*MFNS* IV, 425). After all, movement is undeniably empirical and thus not the same as universality.

To answer that question, we need to go back to the *Critique of Pure Reason* and understand the role Kant assigns to the imagination. Kant charges the *Einbildungskraft* with "synthesis," "the mere effect produced by the imagination" (*CPR* 130). He defines "synthesis" as "the act of putting various presentations with one another" (130), and this synthesis is the ground for cognition, though it is not yet cognition. This "pure transcendental synthesis of imagination . . . underlies the possibility of all experience (inasmuch as this possibility presupposes necessarily that appearances can be reproduced)" (155). As such, the imagination is the ground of possible knowledge, while, at the same time, its development is tantamount to intellectual development itself (Kneller 32). Without imagination, "we would have no cognition whatsoever" (*CPR* 130). He later grants the imagination the power to make cohere the "manifold of intuition," sensibility, and the "necessary unity of pure apperception," or the understanding (170).

Kant's theories of matter shed light on the development of the imagination, that blind faculty necessary for cognition to take place, because one must learn through cautious philosophy to distinguish when the imagination has too much freedom. Although the corpuscular or atomic theory of matter allows for the mathematicization of physics, it must ground itself on the idea of absolute impenetrability, which for Kant must be an empty concept insofar as no experience whatsoever can be capable of proving it. He writes, "Absolute impenetrability is indeed nothing more or less than a *qualitas occulta*. For one asks, what is the reason why matters cannot penetrate one another in their motion? He receives this answer, because they are impenetrable" (*MFNS* II, 503). Despite the fact that fundamental forces can never be rendered certain (Watkins), they amount to more than an empty concept insofar as they have a phenomenality that makes the experience of the effect of them, movement, possible. Kant comments, "The appeal to repulsive force is free of this approach," and here the approach he dismisses relies upon the use of occult things (2: 503). He elaborates, "For although this force likewise cannot be further explicated according to its possibility and must hence be admitted as a fundamental one, it nevertheless yields the concept of an active cause and of the laws of this cause in accordance with the effect, namely, the resistance in the filled space, can be estimated according to the degrees of this effect" (2: 503).[48] By stipulating force to be fundamental and by explaining how force makes matter encounterable, Kant does away with the need for further explication. But Kant further highlights the gains of his approach: the ability to estimate the resistance in the filled space. The reason to choose dynamism over corpuscularity turns out

to be both the avoidance of occult entities and the ability to make predictions based on the theory.

The imagination, then, must learn to distinguish between pure concepts, "empirical concepts that are based on transcendental conditions for their possibility" (Pollok, "Kant's Critical Concepts" 560), and empty concepts, which we either have no phenomenal access to or which are not necessary concepts for thought itself, like time and space and causality. Movement is necessarily empirical, but it can only become the basis for a phoronomy, a part of natural philosophy that examines motion as a pure quantum, when it serves as the basis for the derivation of all further predicates (ibid.). Within science, Kant stipulates further that empirical concepts must be subject to experimental confirmation. The "dynamical mode of explication," Kant urges, "(which is far more suited and more favorable to experimental philosophy) inasmuch as it leads directly to the discovery of the moving forces proper to matters and laws of such forces, but restricts the freedom of assuming empty intermediate spaces and fundamental particles of determinate shapes, (neither of which can be discovered and determined by any experiment)" (*MFNS* IV, 534). The value of dynamism for Kant is that it puts necessary curbs on imaginative freedom—getting rid of empty spaces and determinate shapes—and makes possible experiments that will corroborate hypotheses. Likewise, Schelling required of the atomists "to set limits to the freedom of the imagination" (189) because he found "absurd" the notion that matter could be made up of "infinitely many parts" (189). Crucially, for Kant, dynamism is a mode of "explication." It was not until 1905 that Einstein with his paper on Brownian motion connected diffusion rates implied by this motion to a scale for atoms. Einstein thus showed that evidence for atoms could be found. Previously, atoms were models without scale, useful for chemical shorthand but of dubious reality and without consequence, since one could always shift scales to fit any theory.[49] One might say then, until Einstein, committing oneself to atoms was a materialism without consequences.

Invoking the aid of Boscovich's concept of atoms as centers of attraction and repulsion (1: vi, xxxiv, 24–27), Joseph Priestley, by contrast, collapses matter and spirit in his *Disquisitions Concerning Matter and Spirit*, partly on the grounds that "we know nothing at all of the thing or substance besides the powers that we ascribe to it" (1: 32).[50] Once again matter is necessarily imagined because the essence of its thingness is unknown: all we have access to are its powers. As a result, Priestley argues that he has as much right to say that matter is composed of attractive and repulsive forces as another has to say that it is made up of impenetrability. He believes his view superior, however, in that it recognizes that impenetrability is based on those forces. Solidity is based on resistance, and, in making this claim,

Priestley, like Kant, seeks to make our knowledge of matter conform to the character of empirical experience (J. Edwards 107). But, unlike Kant, he does not look to the regulative principles that are necessary for experience. For Priestley, forces were what we can empirically know about matter, and he contrasts this to an absolutely unknowable idea of invisible corpuscularity. When push comes to shove, Priestley avows that he has made no claims concerning the "internal structure of matter" (*Disquisitions* 1: 35), and that all he has done is quote Boscovich's ideas of points of matter. Once again the interiority of matter is necessarily imagined, making Romantic materiality a form of irony insofar as the gap between appearance and reality can only be temporarily be sutured by thought. As Yolton sums up, "A materialism along these lines need not be opposed to a humanistic conception of man" (200).

Priestley further argued for the existence of a common substance that would allow matter and spirit to interact: without such a substance, it would be impossible to conceive of an interaction between them. He contends, "Let a man torture his imagination as much as he pleases, I will pronounce it impossible for him to conceive even the possibility of mutual action without some common property, by means of which the things which act and react upon each other, may have connexion" (*Disquisitions* 1: 81). The tortured imagination here functions as the basis for a rational argument about common properties: the inability to conceptualize a relation between body and spirit without a common empirical property becomes the basis for the need for that common property. That common property would be force, that which comprises the powers of attraction and repulsion (1: ii). Well aware that this collapse makes it impossible to relegate matter to the source of evil (1: iii), Priestley then unites matter and spirit by making extension into the power of repulsion. Once he has gotten rid of impenetrability as the essence of matter, "the whole argument for an immaterial thinking principle in man . . . falls to the ground" (1: 23). If the downside of his version of matter, however, is that human volition is now governed by a "series of fixed laws" (1: v),[51] Priestley's collapse of body and soul allows the human to work in concert with the divine. In *The Marriage of Heaven and Hell*, William Blake would leverage this collapse into a denial of priestly hierarchy.

Priestley further invokes Newton's restatement of Occam's methodological imperative not to admit more causes than necessary to do away with conventional notions of spirit because he sees Newtonian method as a cure to the excesses of imagination. Not to obey Newton's methods amounts to a "wandering into the regions of fancy" (*Disquisitions* 1: 8), with the result that we are "merely entertaining ourselves with our crude imaginations and conceits" (1: 8). Priestley thus

names Newton the cure to a crude imagination, thereby sobering the imagination with Newtonian judgment.[52] Of course, Newton himself could have used such sobering, for, in his adoption of ether, Priestley points out that he has violated his very own principles (1: 30). Priestley's reasoning merits full consideration: "The reason why solid extent has been thought to be a complete definition of matter is because it was imagined that we thought we could separate from our idea of it everything else belonging to it, and leave these two properties independent of the rest, and subsisting by themselves. But it was not considered, that, in consequence of taking away attraction, which is a power, solidity itself vanishes" (1: 11). The vulgar notion that the essence of things is composed of solid extension is based upon an imagined separability of our idea of the power of solidity from its properties. Once again, since those very properties are based on the power of attraction, the imagination is in error when it separates ideas and things, or what Heidegger referred to as propositions and things. My point here is not only that the imagination is central to thinking about matter, but also that its errors have material impact since it affects our understanding of what matter is and does. Priestley in fact repeatedly insists that we have "imagined" solidity to be the ground of materiality (1: 17, 44), and thus the vulgar notion of things is really nothing, an unsubstantiated hypothesis. In fact, Priestley wryly retorts, without some idea of power, "nothing would be left for the imagination to fix upon" (1: 13). In much the same way as he collapses matter and spirit, Priestley's imagination needs things to fix upon, for, without them, there is no content to consciousness. Like Kant, Priestley insists there simply is no warrant for a thing underlying the powers of attraction and repulsion because such a thing "does not appear from any phenomenon we are yet acquainted with" (1: 21). "The kind of matter on which the two-substance view is based does not exist" (Yolton 114). The fact that the thing is really a power or force allows mind and matter to interact. In Priestley's view, materiality becomes that which conforms to the character of our experience of it, and thus materiality is a form of intelligibility. Matter and spirit are thereby indissoluble. To wit, he argues, "In this disquisition, I by no means suppose that these powers, which I make to be essential to the being of matter, and without which it cannot exist as a material substance at all, are self-existent in it. All that my argument amounts to, is, that from whatever source these powers are derived, or by whatever being they are communicated, matter cannot exist without them" (*Disquisitions* 1: 13). Several features demand comment. Priestley admits that he has *made* these powers essential and thus essence is his construction; he further insists that he is not supposing the "self-existence" of these powers. Priestley is in effect turning to the imagination to make essentialism a necessary strategy rather than an ontological claim.[53]

Priestley intensifies such bonds when he addresses readers, whom he imagines to be "well meaning Christians . . . of a philosophical turn of mind" (*Disquisitions* 1: x), by which he means rational Christians. He hopes that they may be prevailed upon, having found "the true system of revelation to be quite another thing than they had imagined it to be, and infinitely more consonant to the real appearances of nature, may think it worth their while to consider it in various other lights, and attend to the evidence that myself and others have produced in favour of it" (1: x–xi). Although revelation is initially imagined to be quite different from the "appearances of nature," Priestley insists that revelation conforms with those appearances and, in so doing, collapses matter and imagination under the rubric of "appearances of nature" (1: xi). Matter can be known only by its appearance and thus is imagined. At the same time, Priestley suggests that the imagination is open to correction by evidence, even when the form of that evidence is different from what one initially expects. First, matter therefore must be imagined in two ways: since its essence cannot be known, all one can talk about is its appearance. Second, since its appearance is different from its actuality, matter must remain under the sign of difference and thus cannot function as a surrogate for logocentrism.[54] This further implies that the deferral we have credited to the powers of language originally belonged to the powers of matter.

Within chemistry, much speculation went into understanding the reasons why substances had "preferences" for certain kinds of reactions. Affinity began to replace a principalist approach, whereby "the properties of bodies were determined by the kind and quantity of the principles contained in them" (M. Kim 116). In a model where principles were the causal agents engendering the properties (Klein and Lefebre 44), composition determines affinity; under affinity, affinity determines composition (M. Kim 145). Here, essence moves away from substance and toward the attraction of the substance for another substance, not only making the essence of things attractive forces that have the potential to combine with other things but also rendering substances as actions. The famous German chemist Georg Ernst Stahl believed in "an Anima, a conscious, rational, immaterial principle in living substance responsible for the unique properties of life" (Schofield, *Mechanism* 200–201). The anima directs the immaterial motions of matter, exhibiting intention and denying determinism (200).

I have thus far argued that Romantic materiality was necessarily imagined, making the citation of the material a conscious strategy instead of an ontological claim. Linking the material with strategy not only made matter about possibility instead of determinism but also enabled matter to be put to use to help get rid of tyranny. Humphry Davy taught himself chemistry by reading Lavoisier, and, per-

haps because the French chemist, to make chemistry purely analytical, neglected the internal constitution of matter (Goodstein 3), Davy took a different path. Early on, Davy thought that matter was essentially dynamic: "Far from being conscious of the existence of matter, we are only conscious of the active powers of some being" (cited in Levere, *Affinity* 26).[55] His chemical experiments led to his discovery of sodium and potassium, among other elements. Davy's emphasis on active powers made the chemistry of matter about interactions (Goodstein 5); his attempts to prove that electrical forces are really chemical forces enabled him to provide a universal explanation for matter (Chai 126). My point here is that Davy aligns matter with activity and change, and he often turns to the imagination to think about it.[56] The imagination moreover helped him to claim the role of a natural philosopher, one whose theoretical knowledge, on the one hand, lent him authority over chemical artisans and, on the other hand, got his critics to accuse him of being overly passionate and unreliably speculative (Golinski, *Experimental Self* 185).

On January 21, 1802, Davy gave an introductory lecture on chemistry at the Royal Institution, which Coleridge attended, claiming that "chemistry takes the beings and substances of the external world [and] explains their active powers" (C. Lawrence 220).[57] Around the same time, he wrote in a notebook:

> All our visible imagery occurs in trains, hence when we meet with unconnected images we fill up the intermediate links by imagination
>
> What is imagination, almost always the recurrence of remembered visible imagery under the influence of hope and fear
>
> When we awake our trains of imaginations are perpetually broken by Impressions, In dreams all ideas are nearly of the same vividness.
>
> ("Personal Notebooks" 13/D, 1800)

In the same way that Kant turns to the imagination to synthesize the manifold of presentations, Davy has the imagination fill in the blanks of any unconnected images in our trains of imagery. Quite literally so here, as the reader must fill in the gaps between statements. However, unlike Kant, Davy stresses how the imagination is influenced by the emotions of hope and fear, thus inviting a double consciousness with regard to it. When we are awake, the trains of imagination are broken and, therefore, presumably are more easily subject to judgment. To the extent that the imagination fills in perceptual blanks when it is guided by hope and fear, it can be dangerous to science, and the only way to impose judgment over it

is to treat such imagery with suspicion. Indeed, Davy's language here recalls what he said about nitrous oxide: "I lost all connexion with external things; trains of vivid visible images rapidly passed through my mind" (Davy, *Works* 3: 289). Nonetheless, he calls "reason, the first revelation" ("Personal Notebooks" 13/E, page 5), and in so doing casts aspersion on the reliability of the second revelation, by which he means the "absurd" biblical account of it.[58] The revelations of reason thus were needed to counter the mystical revelation of the Bible, and thus it is hardly surprising that he would develop suspicion regarding the imagination, especially after he likened it to the effects of laughing gas. Perhaps the gap between the two kinds of revelation would help shape the imagination's scientific role.

To that end, Davy opened his 1812 *Elements of Chemical Philosophy* by pronouncing, "Most of the substances belonging to our globe are constantly undergoing alterations in sensible qualities, and one variety of matter becomes as it were transmuted into another" (4: 1). The imagination affords initial speculations about chemical changes that with the proper experiment might eventually provide the basis for a scientific advance. But Davy cautions that "theories are merely systems of logic and not systems of the universe[; moreover,] alterations in words are not connected with alterations in things" (*Lecture Notes* HD/3/A/1, pages 33–34). Mindful of the gap between logic and the universe, Davy demands that neither thinking nor logic be equated with knowing.[59] In an 1806 paper, "On the Relations of Electrical and Chemical Changes,"[60] he writes, "I shall detail an experiment which I made under a different form some years ago, and which may assist the imagination in the conception of this singular and mysterious mode of action" (*Works* 6: 338). Experiments here lead the imagination to conceptualize modes of action not visible on the surface, thus making chemical action intelligible. The key, however, was not to mistake intelligibility for ontology. Three years later, he wrote, "Doubt in physical research is highly salutary; & is always the parent of enquiry, and often of truth. Though our reasonings may have the perfect character of verisimilitude as applied to known objects, yet we have no right to say that our view is an ultimate one. Our systems of logic cannot unfold all the resources of nature" (*Lecture Notes* HD/3/A/4, lecture 4, pages 106–07). Surprisingly, his use of "verisimilitude" asserts doubt, making identity into appearance.[61] He later explicitly associated the imagination with powers of intelligibility, but not truth, when he commented, "This mechanical doctrine was considered as so just that several of the earlier observers with the microscope attempted to discover these [illegible] in acid fluids; and here were not wanting some who carried their imagination so far as to believe they had actually seen them" (*Philosophy of Experi-*

mental Chemistry 10).[62] In stressing the limits of how far one could and should carry the imagination, Davy was not trying to eliminate it but rather to warn against mistaking intelligibility for claims about things.

His suspicion of imagination was intensified by the fact that he could not do without it. In a letter to Thomas Poole, Davy claimed to be "a lover of Nature, with an ungratified imagination" ("Letters" May 1803). Presumably, the ungratified state of his imagination is what continually orients him to the scientific study of nature, a point underscored in his "Introductory Lecture for the Course of 1805" when he announced that "the works which awaken the imagination and exalt the feelings have preserved all their effect upon the mind" (*Works* 8: 162).[63] Again, imagination is what entices, and has effects on, the mind. Speaking in 1810 of nature's "infinite diversity of forms," he notes their powers to "haunt the imagination as sources of the magnificent and the beautiful" (*Lecture Notes* HD/3/B/9, lecture 10, page 166). Imagination here endows the diversity of nature with a spectral quality whose haunting drives scientific inquiry.

Historians of science have been embarrassed by Davy's imaginative speculations, his presumptuousness, but his thinking about the imagination is more careful than is acknowledged.[64] He articulates an initial position that seems hostile to the imagination, commenting, "For experiments alone constitute the strength and vitality of our philosophical arrangements; these are things themselves whereas even the most perfect hypotheses are but as shadows of things" (*Works* 8: 317). Hence, Davy chides Dr. Black because his "ultimate particles or atoms are mere creatures of the imagination" (9: 363), and this meant that imagination needed corroboration of some kind. Davy even considered that a research program might even cure an unhealthy imagination: he wrote that "the pursuit of experimental research . . . may destroy the diseases of the imagination, owing to too deep a sensibility" (2: 326).

Davy knew no German; he had learned about Kant from his reading of F. A. Nitsch's 1796 *A General Introductory View of Professor Kant's Principles Concerning Man, the World, and the Deity* (Levere, *Affinity* 29) and thus may owe this understanding of the imagination to Nitsch's version of Kant.[65] Nitsch rehearsed Kant's claim about the reproductive imagination, "which reproduces what has been connected and collected, in order that the immediately preceding affections may be annexed to those immediately succeeding; and for this reason this act may be called a synthetical act of the reproductive imagination" (76). By "reproductive," Kant indicated the ways in which imagination synthesized collected data and limited the work of imagination to the passive offices of collection and synthesis. Nitsch does not discuss Kant's more creative imagination, the productive one, and when Davy makes "the food of the imagination" the senses, he too is

limiting the imagination to reproductive work rather than creativity. Instead of embodying synthesis spontaneously in the way Kant suggests, Davy's idea of imagination makes it the catalyst to such synthesis through analogy.[66] Davy wrote, "The chemical enquirer cannot enter like the poetical enthusiast at once into the middle of his object and make the results of observation subservient to an exalted imagination. He must begin by using coarse and material instruments" (*Lecture Notes*, HD/3/A/4, lecture 4, page 103). Having closed the door to the enthusiastic imagination, Davy then argues, "He must witness their effects, trust wholly to sensible results and [list?] all prime analogies" (ibid.). The imagination nonetheless can help see analogies that may be fruitful.

Immediately, however, Davy qualifies his resistance to the imagination, acknowledging it to be indispensable to discovery. He writes, "In making this declaration, it must not be supposed, however, that I am arguing generally against conjectural inferences, or attempting to prove that the imagination ought to be passive in physical research. This would be giving up a noble instrument of discovery; for analogy is in science what the blossom is in vegetation, beautiful and replete with promise, and may ripen into useful fruit" (*Works* 8: 317). Davy recognizes the value of the imagination in generating conjectures and analogies that will provide fodder for experiment—crucially, the fruits of imagination must "ripen"—but only insofar as he instrumentalizes it into a means of discovering something that will later be proven to be real.[67] In his 1806 "Bakerian Lecture" titled "Some Chemical Agencies of Electricity," he spoke of how the "imagining [of] a scale of feeble powers" would help "account for the association of the insoluble metallic and earthy compounds" (5: 55). Accounting generates possible experiments. Davy again connected the imagination to the operationalization of experiment in his letter to Reverend E. D. Clarke of 1816. While trying to replicate the mineralogist's results, Davy wrote, "I cannot imagine an advantage from using Nitrate of Barytes" ("Letters"). He then inquired whether the reverend was sure his barytes was pure. The experimenter must imagine the substances and the means that will provide the most advantages. In his experiment on nitrous oxide, moreover, he remarked that it "appeared to act as a diuretic, and I imagined that it expedited digestion" (Davy, *Works* 3: 141). Properly used, the imagination speculates and brackets its claims in terms of speculations that must be confirmed by experiment.[68] Of course, it was his ability to imagine the voltaic pile as the instrument for pulling apart compounds that helped him to make so many discoveries. He also had to imagine how to refine it, and he used more purified materials as well as more expensive platinum wires to increase its power (Golinski, *Experimental Self* 109).

In making the imagination the source of analogy, Davy indirectly credited it for allowing him to unify previously distinct kinds of matter in a "unified, cross linked pattern" (Levere, *Affinity* 40). And, indeed, Davy fervently hoped to unify the basic forces of matter because that bespoke God's infinite wisdom. His 1809 "Electro-Chemical Lectures" announced, for example, that although electricity and chemistry "appear to be separate & distinct, [they] are scions from the same stock, [and] when profoundly examined, are discovered to have a common origin and to be governed by analogous laws" (*Lecture Notes* HD/3/A/1, page 32). While analogy, then, provided some inkling of unity, dynamism reinforced that unity. By his third lecture in that series, he asked, "But are these electrical energies or attractions of bodies and the chemical affinities coincident in force?" ("Electrochemistry" HD/3/A/3/4, page 79). If proven true, then physics and chemistry could be united by the study of force.

In an 1822 paper, "On the State of Water and Aeriform Matter in Cavities found in Certain Crystals," published in the *Philosophical Transactions*, Davy again connected the imagination to analogy. "The imagination is excited by the magnitude of the operations [of nature during the earth's history], by the obscurity of the phenomena, and the remoteness of time at which they occurred; and all the intellectual powers are required to be brought into activity to find facts or analogies, or to institute experiments, by which they may be referred to known causes" (*Works* 6: 207). Prompted by the excitation of the imagination, then, the intellectual powers work either to find facts or analogies that will provide the basis for future experiments. Davy wrote in a notebook entry dated 1816–21, "May it not be imagined that the monads or spiritual germs which animate or create organic frames, have no relation to space, and pass from system to system wholly unlike matter, which is limited to its own gravitating sphere. Is not light the first envelope of the monads, and may not my earliest hypothesis be true?" ("Notebooks" 119). Even at the end of his career, when he wrote *Consolations in Travel*, Davy insisted, "With respect to the higher qualities of intellect necessary for understanding and developing the general laws of the science [of chemistry], the same talents are required for making advancement in every other department of human knowledge . . . The imagination must be active and brilliant in seeking analogies; yet entirely under the influence of judgment in applying them" (9: 366). So long as imagination remains under the discipline of judgment, it can remain active and brilliant. Moreover, the analogical powers of imagination allow natural philosophers to group phenomena together so that they build upon on another and demonstrate the unity within multeity of the world.

As the above examples show, awareness of the imagination's limits could lead

to more effective forms of discipline. In an April 1799 letter to Davies Giddy, the engineer who recommended Davy to Thomas Beddoes for his Pneumatic Institute, Davy commented, "The supposition of active powers common to all matter, from the different modifications of which all the phenomena of its changes result, appears to me more reasonable than the assumption of certain imaginary fluids alone endowed with active powers, and bearing the same relation to common matter, as the vulgar philosophy supposes spirit to bear to matter" ("Letters"). Here "imaginary" paradoxically helps him distinguish between warranted and unwarranted supposition.

In his 1810 "Researches on Oxymuriatic Acid," published in the *Philosophical Transactions*, Davy develops how imagination can remain part of the experimental process. These experiments were part of his campaign to disprove Lavoisier's assumption that acidity was dependent upon oxygen. Lavoisier had derived "oxygen" from the Greek, meaning "acid producer." Muriatic acid was extracted from sea salt (Goodstein 64), and Davy knew that adding oxygen to muriatic acid diminished its acid properties. Davy wrote, "When a solution of oxymuriatic acid in water is electrized, oxymuriatic acid and oxygen appear at the positive surface, and hydrogen at the negative surface, facts which are certainly unfavourable to the idea of the existence of hyper-oxygenized muriatic acid, whether it be imagined a compound of oxymuriatic acid with oxygen, or the basis of oxymuriatic acid" (*Works* 5: 295). Davy used Volta's battery to decompose oxymuriatic acid into its components, and this is how he discovered chlorine and replaced the debunked phlogiston with hydrogen (Goodstein 78–79).[69] By mixing oxymuriatic acid with water and by decomposing this mixture, Davy argues that hyper-oxygenized muriatic acid does not likely exist. But, to do so, he must imagine what the decomposed form of hyper-oxygenized muriatic acid looks like, and he imagines two forms of it, a compound and a basis from which oxymuriatic acid can be derived so he can refute their existence.

Davy carefully models how the imagination should be used in science and in the treatment of matter. His early research papers refer to the imagination to indicate an idea not yet demonstrated. In his experiments on nitrous oxide, for instance, he notes that Mr. Kirwan, "from the non-coincidence in the accounts [of the composition of nitrate of ammonia], has imagined that it is partly decomposable" (*Works* 3: 52). On the one hand, he praised Benjamin Franklin, "who conceived the bold idea of bringing lightening from the clouds, who first imagined that by pointed conductors charged electrical clouds might be made more harmless" (*Lecture Notes* HD/3/B/3/4, page 78). He thus credited the imagination as the source of the conception of one of the Enlightenment's most famous experi-

ments. On the other hand, he chastises Ritter because "in some of his conclusions he seems to have followed the impulses of strong imagination rather than the results of observation" (85). He pits observation against impulse. Nonetheless he notes that "science is indebted to him for the invention of several happy combinations" (ibid.).

In the Romantic period, scientists debated whether heat was a substance (caloric) or merely a form of energy. Davy opens his lecture on heat by pronouncing, "I once had this idea. It satisfied the imagination; but, not the reason" (*Lecture Notes* HD/3/B/3/4, page 53). He elaborates, "If we suppose the [heat as] fluid and this fluid carries heat with it whence can its heat be derived; if we conceive it to be heat or light why should it be resolved into heat or light at the amount that it is strongly attracted by matter" (ibid.). Davy makes it clear that satisfying the imagination is easy and that reason is a much harder taskmaster. "The only use of an hypothesis is that it should lead to experiments" ("Electrochemistry" 100), he insists. Nonetheless, the imagination generates hypotheses that make possible the experiment. He warns that "the chemical enquirer cannot enter like the poetical enthusiast at once into the middle of his object and make the results of observation subservient to an exalted imagination. He must begin by using coarse and material instruments" (*Lecture Notes* HD/3/A/4, page 103). In sum, then, Davy enlists the imagination in aid of experiment but makes the outcomes of experiment the final arbiter of its value. Davy labels the exalting of the imagination over observation in terms of an excess of enthusiasm, a charge others lambasted him with in his early career.

Jane Marcet, the wife of Keats's chemistry teacher and of whom Faraday had a high opinion, wrote an important and popular handbook of chemistry for women, *Conversations on Chemistry*, and was inspired to do so after having attended one of Davy's courses (Golinski, *Science as Public Culture* 194).[70] Framing instruction as a dialogue between Mrs. B. and her pupils, Marcet explained that the goal of chemistry was "to obtain the intimate nature of bodies, and of their mutual action on each other" (28). She instructed her pupils that the force of attraction could be calculated by figuring out the force that it took to separate compounds. And she emphasized that matter was held together by forces of cohesion and attraction. She explained that heat and electricity worked together to "exalt the electrical energies of bodies, and consequently their force of attraction facilitates their combination" (122). For Mrs. B., the imagination is a pedagogical tool that assists in intelligibility. For example, after listing the various material components of plants, she cautions her pupils, "You must not imagine that every one of those materials is formed in each individual plant" (295).

No treatment of dynamism in the Romantic period would be complete without looking into the career of Michael Faraday, inventor of the motor and discoverer of the magnetic field.[71] Faraday is central to understanding why some scientists thought that the essence of matter was force. Trained as a bookbinder, Faraday got his start in science after having attended Davy's lectures at the Royal Institution and having bound and indexed those lecture notes and given them to Davy.[72] Davy was so pleased, he hired him initially as his assistant while on continental tour and later as his lab assistant. Crucially, for the purposes of grasping the relation of the history of matter to the imagination, Faraday thought of himself as both a "very lively, imaginative person, [who] could believe in the Arabian nights as easily as in the Encyclopedia [Britannica]" (cited in James, *Michael Faraday* 22), and insisted, "I must keep my researches really *Experimental* and not let them deserve anywhere the character of *hypothetical imaginations*" (*Diaries* 2: 184; cited in Levere, *Affinity* 86). "Experimental," then, could not acquire any epistemic virtue, if the temptation to imagine were not always present. Matters were especially tricky, given that Faraday did not think the contemporaneous notions of electrical current were sufficiently precise.

Because of his self-professed imaginativeness, Faraday turns to experiment to counter the hypothetical imagination.[73] However, experiment could not function as a cure-all. Faraday recognizes the imagination's complexity when he refers to it while trying to parse the meaning of an experiment. Writing to Charles Daubeny, reader in chemistry at Oxford University, about his attempts to decompose water and thus deny its elementality, he stated, "I can imagine the oxygen leaving the hydrogen only because it from some cause or other is no longer in the relation of a supporter of combustion and if it be imagined to lose its power of combination with hydrogen, I see no reason why it should retain its power of combination with sulphur" (James, *Correspondence* 1: 405). Here, imagination is needed to understand what one is looking at. Part of the story I want to tell here is how Faraday shifted from thinking about magnetic lines of force—which became the field—as concepts and when he understood them to be physical things. As lines of force became material, what role, if any, did the imagination play? As we shall see, for Faraday, materiality begins as imagination, but this meant that the imagination had first to be properly disciplined.

Like so many scientists before him and in much the same way that Romantic critics link it with escapism, Faraday initially dismissed the imagination. In a recently discovered early essay dated August 1818, "On Imagination and Judgment," Faraday wrote, "I may by Fancy led wander in the realms of Fairy land and see shepherds with their flocks, woods castles mountains of snow and as great a variety

as there are changes in the scene . . . This I consider the province of Imagination. It requires no exertion of the mind but naturally produces a considerable degree of sensitive pleasure" (Jenkins 52).[74] Faraday thus equates the imagination with a kind of spontaneous and irresponsible reveling in the pleasures of sensation, and he contrasts the imagination with the rigorous labors of induction, an "operation of mind [that] produces no pleasure of sense but on the contrary a degree of pain owing to the necessary concentration of the mental powers to one object for a lengthen'd [*sic*] time" (53). He insists, it is because ratiocination is so difficult that there is an "almost universal inclination . . . to follow the airy whims of Imagination" (ibid.). Thus far, it would seem that never the twain of science and the imagination shall meet, and historicist critics of the imagination are right in their insistence that the imagination is about the dereliction of duty. However, Faraday cannot simply let go of the imagination because it works spontaneously and because it can be the source of knowledge production if disciplined. He comments, "There is a much greater difficulty in following up an idea which reason teaches us is for our benefit, than that which is spontaneously dictated by the imagination" (52).

Perhaps to deal with what Hume called the impotence of reason to motivate, Faraday immediately offers a definition of imagination that allows it to work symbiotically with judgment. He argues, "Still I consider that Imagination owes as much to judgement as judgement does to imagination. When a decision is made Imagination immediately enlists it under its banner to enrich and increase the extent of its operations. Altho' the feeling arising from judgement is not a sensitive pleasure it is of a nobler kind" (Jenkins 54). In this formulation, the imagination is no necessary enemy to science because it works in concert with judgment. Indeed, Faraday sets them up to work chiastically: imagination enriches the extent of judgment's operations while judgment enhances the imagination. While he is more reticent on the latter, he does credit imagination with extending the range and richness of a decision's operations: its motivating powers. He concludes by praising the wisdom of the deity for requiring the same kind of exercise for the mind as for the body: "to drive away ignorance and superstition and to keep in proper bounds the delusive vapours of Imagination" (ibid.).

We can perhaps now piece together how Faraday thinks judgment can enhance the imagination by looking at his Friday Evening Lectures, published in the *Athenaeum*.[75] In the lecture of January 24, 1834, Faraday recounted a new law of electric conduction: "Suppose metals have a specific power of attraction for gases, totally different from chemical affinity; and second, by their peculiar condition of elastic bodies when mixed" ("Abstracts," F/13/F(1), page 29). Such said Mr. Faraday "is my theory: everyone is, of course, partial to the child of his own imagina-

tion: and I have not after much pains, been able to see where this is deficient" (ibid.). His implication here is that because one is inevitably partial to one's imagination when it produces its own theory, even more judgment than usual is needed when the theory is one's own. Faraday's preferred form of demonstrated judgment was epistemological modesty, and such modesty often took the form of labeling speculation as speculation and fact as fact, and especially so for one's own speculations.[76]

As the above example indicates, Faraday invoked the imagination as a form of epistemological modesty. Just how important epistemological modesty was to Faraday can be seen in an 1819 lecture on matter where he declares his opinion that the electrical agency of matter "inclines to the immaterial nature of these agencies" ("Lectures on Chemistry" 507).[77] Crucially, Faraday frames the immateriality of these agencies as an "inclination." Nonetheless because he considered matter to be basically a network of forces, forces could paper over the not yet known properties of electricity.[78]

In the essay, Faraday struggles to make sense of what it means that as matter moves from solid to fluid to gas, "physical properties diminish in number and variety" ("Lectures on Chemistry" 505). Faraday's implicit conclusion is that what we take as real properties are not in fact real. He goes on to write:

> Nothing is more difficult and requires more care than philosophical deduction, nor is there any thing more adverse to its accuracy than fixity of opinion. The man who is certain that he is right is almost sure to be wrong, and he has the additional misfortune of inevitably remaining so. All our theories are fixed upon certain data, and all of them want alteration and support. Ever since the world began opinion has changed with the progress of things and it something more than absurd to suppose that we have a sure certain claim to perfection or that we are in possession of the acme of intellectuality which has, or can result from human thought. ("Lectures on Chemistry" 508–09)

Faraday here codifies the dangers of certainty and fixed opinions, and offers scientific epistemological modesty as a cure to them; moreover, he turns to imagination to signal that modesty. His claim that facts had saved him is here complicated by his recognition that the data itself was constantly changing, and therefore facts were changing. If facts change as the data changes, then doubt must prevail over ontology, but that doubt potentially will be overcome through future scientific work. In the 1820s Faraday, through a series of experiments, came to reject the idea that electromagnetism was composed of forces of attraction and repulsion, and instead he argued that it was made up of dynamic circular motion (Steinle,

Exploratory Experiments 235–37). Well aware of how little about electricity was actually known, he in 1834 warned, "We may imagine, but such imaginations must for the time be classed with the great mass of doubtful knowledge which we ought rather to strive to diminish than increase; for the very extensive contradictions of this knowledge by itself shows that but a small portion of it can ultimately prove true" (*Experimental Researches* 1: 288). Faraday thus employed "imagination" in order to bracket claims in terms of doubt.

Twenty years later, Faraday would underscore the imagination's proper role in self education as the cultivator of doubt. In his "Observations on Mental Education," he insisted, "I hold it as a great point in self-education that the student should be continually engaged in forming exact ideas" (Jenkins 207). He added, "I should be sorry, however, if what I have said were understood as meaning that education for the improvement and strengthening of the judgment is to be altogether repressive of the imagination, or confine the exercise of the mind to processes of a mathematical or mechanical character" (ibid.). "I believe that, in the pursuit of physical science, the imagination should be taught to present the subject investigated in all possible and even impossible views; to search for analogies of likeness and (if I may say so) of opposition—inverse or contrasted analogies; to present the fundamental idea in every form, proportion, and condition; to clothe it with suppositions and probabilities,—that in all cases may pass in review, and be touched, if needful by the Ithuriel spear of experiment" (ibid.). Faraday makes clear that exactness of ideas should not repress the imagination. Moreover, if the imagination is above all a faculty to be taught, it is not to be restricted to the realms of the possible and should even contemplate inverse analogies. Faraday highlights the uses of the impossible by invoking spear of the angel Ithuriel, because no falsehood can allegedly withstand the touch of this spear. He thus gives experiment mythical properties. In keeping with his epistemological modesty, however, Faraday insists that since ideas can take multiple forms and are to be "clothed" in suppositions: aesthetic embodiment is not to be mistaken for ontology.

Given his careful reflections upon the uses of imagination, it is no surprise that Faraday's *Diaries* and published papers repeatedly show his reliance upon the disciplined imagination during experiment.[79] While thinking up ways to strengthen the power of a zinc battery, Faraday decides to try amalgamated zinc. He writes, "It might at first be imagined that amalgamated zinc would be much inferior in force to common zinc, because of the lowering of its energy, which the mercury might be supposed to occasion over the whole of its surface; but this is not the case" (*Experimental Researches* 1: 306). Faraday's "at first" brackets the imagination's claims as provisional, granting them a necessary sell-by date. In another

instance, he considered imagined things as offering possibilities to be negated. He insists, "With all these precautions the results were the same: and it is thus very satisfactory to obtain the curved inductive action through solid bodies, as any possible effect from the translation of charged particles in fluids or gases, which some persons might imagine to be the case, is here entirely negativized" (1: 385). He also thought that if he could prove that "gravitation requires time," that would, in turn, prove that a "physical agency existed in the course of the line of force" (*Faraday's Diary* 2: 409).[80] And yet the paradox remains that although imaginative speculation introduces the possibility of delusion, its speculations are not necessarily delusional, and, thus, without it, experimental advances are not possible. In this way, imagination enables the discovery of physical truth. Commenting on Berzelius's theory that heat and light evolved in cases of combustion, Faraday cautioned, "We may imagine, but such imaginations must for the time be classed with the great mass of doubtful knowledge which we ought rather to strive to diminish than to increase" ("Annotated Offprints," F/3/C, paragraph 959). As late as 1859, while testing the relation of heat, electricity, and gravity, he wrote in his *Diary*: "Let us encourage ourselves by a little more imagination prior to experiment. Atmospheric phenomena favour the idea of the convertibility of gravitating force into Electricity" (7: 336). He adds, "Let the imagination go, guarding it by judgment and principle, but holding it in and directing it by *experiment*" (7: 337).

Having shown how Faraday carefully sought to partner imagination with experiment, I now return to the issue of dynamism.[81] In his 1816 chemistry lectures, Faraday is unsurprisingly wary about claiming that forces are the essence of matter, but he is moving in that direction.[82] On January 19, 1816, for instance, he told his peers, "Chemistry is the knowledge of the powers and properties of matter" (1). After describing the properties "generally considered as essential to matter; as extension, solidity, tangibility, divisibility, inertia & c," he proceeds to acknowledge that "these essential characters, have however, been doubted by some, and even solidity in the common acceptation of the word, denied to matter" (3). Faraday sees essence as a problem and does not know what is its ground since ideas are inseparable from properties. Despite the articulated doubts of others, Faraday announces, "It would be improper however to pass them [the supposed essential properties] entirely unnoticed" (3). Although he admits, "We are able, in some degree, to form ideas of the properties of matter abstracted from itself; and we can discuss the phenomena of attraction or repulsion" (2), he recognizes the limitations of a force approach within chemistry, which cannot get to the individual properties of matter. He ends this discussion by talking about gravity as a property of matter, and by gravity he means attraction (7). While doing experiments in

which he tried to measure the effect of the strength of an acid on electrical voltage, he noted that the oxygen disappeared: "I have not yet had the time to examine minutely the circumstances attending the disappearance of the oxygen in this case, but imagine it is due to the formation of the oxywater" (*Experimental Researches* 1: 214). "Imagine" is the spur to a further experiment that will provide evidence supporting causality, the placeholder until he has the time to carry out those experiments. Sure enough, his next researches probe "the primary or secondary character of the bodies evolved at the Electrodes" (1: 218), either the hydrogen or oxygen.

As he deepens his experimental researches, Faraday licenses himself to evoke the imagination more positively because he has repeatedly shown his powers of self-discipline. He does so when he needs to imagine how far to extend the implications of his results. He argues, "The results connected with different conditions of positive and negative discharge will have a far greater influence on the philosophy of electrical science than we at present imagine, especially if, as I believe, they depend upon the peculiarity and degree of polarized condition which the molecules of the dielectrics concerned acquire" (*Experimental Researches* 1: 485). Although he imagines a future when this idea will sharpen research, he is at the same time careful to label his ideas as beliefs yet to be proven.

Faraday abandons the idea of atoms in May–June 1833 and then becomes a dynamist, adopting the centrality of forces of matter. Faraday's discovery of electromagnetic induction in 1831 had raised the issue of how electromagnetic forces were propagated (Harman 73). An analysis of the shift between series 4 and series 5 of his *Experimental Researches on Electricity* helps explain why.[83] In series 4, Faraday explored the increased conductivity of electricity when something was liquefied. In series 5, he takes on electrochemical decomposition. Whereas, in the former series, Faraday's emphasis is on how solidity "chain[s] particles to their places, under the influence of aggregation" (1: 118), in the latter, he stresses forces, attraction, repulsion, and power (1: 143). He notes that "M. de la Rive considers the portions of matter which are decomposed to be those contiguous to both poles" (1: 139). One major objection Faraday has to atoms is how to understand the space between atoms that this theory requires. Contiguity, thus, is suggestive of continuous forces and is a denial of atoms, spaces, and the occult workings of action at a distance even as it substitutes contiguity for direct touching as the form of causality.[84] Of course, contiguity is almost a kind of action at a distance that forces make palatable. The key shift occurs in paragraph 524: while attempting to entertain the cause of electro-chemical decomposition, "I conceive the effects to arise from forces which are internal, relative to the matter under decomposition—and

not external, as they might be considered, if directly dependent upon the poles" (1: 151). He then "supposes that the effects are due to a modification, by the electric current, of the chemical affinity of the particles through or by which that current is passing" (ibid.). He prefers his explanation because "the effect appears to be a natural consequence of the action: the evolved substances are expelled from the decomposing mass, not drawn out by an attraction which ceases to act on one particle without any assignable reason" (1: 155). He concludes that his theory based on forces "seems to me at present to leave nothing unexplained" (1: 156); after all, expulsion did away with the need to explain why attraction ceases. Faraday also thinks that electrical scientists have misunderstood the source of attractions. On the one hand, dynamism and forces thus offer complete intelligibility, leaving no mysterious entities like action at a distance to be explained. On the other hand, dynamism is a both supposition, not a claim of ontology, and a claim of proximity as action without distance.

We now come to the moment when Faraday considers "lines of force" to move from a concept to a physical entity. These "lines of force" become the basis for the magnetic field.[85] Unlike Ampère, who thought that electromagnetic forces acted at a distance, Faraday turned to lines of force because their interactions with each other and with matter "gave rise to all electrical, magnetic, and electromagnetic phenomena" (Steinle, *Exploratory Experiments* 7). I have suggested that Faraday's epistemological modesty prevents him from too readily making ontological claims. In his view, the ontological claim is a risk of immodesty, one that potentially undermines Faraday's claim that he knows the difference between imagination and fact. In this light, imagination becomes central to the work of science because science is a continual process of improvement. As new data appears, and as facts shift, framing one's ontological claims as imagined allows the caution of the scientist to reframe continually new data and facts in relation to the evidence. Early on, Faraday invokes the imagination when thinking about how to think about electrical and magnetic force. For instance, while explaining Arago's magnetic phenomena, Faraday writes, "If a wheel[86] be imagined, constructed of a great number of these radii, and this revolved near the pole, in the manner of copper disc[87] each radius will have a current produced in it as it passes by the pole" (*Experimental Researches* 1: 34). Here the imagination creates an image that is useful for thinking, but Faraday does not mistake this image for actuality.[88] In 1837, he explicitly states that "lines of inductive force and curves lines of force . . . are imaginary" (*Experimental Researches* 1: 39).

A comparison of his two published papers, "On the Lines of Magnetic Force," published in the Royal Society's January 1852 *Philosophical Transactions*, and

"On the Physical Character of the Lines of Magnetic Force," dated June 1852, which he thought more appropriate for the more speculative *Philosophical Magazine*, is instructive. In the former paper, he underscores that "the term line of magnetic force is intended to express simply the direction of the force in any given place, and not any physical idea or notion of the manner in which the force may be there exerted" (*Experimental Researches* 3: 402).[89] He concludes that paper, "The lines of force well represent the nature, condition, direction, and amount of the magnetic force" (3: 406). Here, his insistence on the lines as a form of representation makes them vectorial, and they do not amount to a claim of ontology, despite his use of the terms "nature" and "amount." Just five months later in the second paper, Faraday explicitly brackets his claims about physicality as speculation and then proceeds to defend the value of speculation: "Though I value them highly when cautiously advanced, I consider it as an essential character of a sound mind to hold them in doubt; scarcely giving them merely as probabilities and possibilities, and making a very broad distinction between them and the fact and laws of nature" (*Experimental Researches* 3: 408).

One can thereby understand why the imagination would play such a key role in the ontologization of the magnetic field: it suspends them in doubt so they can earn their reality. Of particular interest is the fact that, rather than espousing the proverbial view from nowhere we have come to expect expected from science, Faraday insists on the soundness of his mind, which he demonstrates by emphasizing his doubts. Doubts are central to science, and, to the extent that the imagination can be used to enhance skepticism by bracketing as of yet unproven claims as opinion or speculation, it is not something for a scientist to fear. Indeed, insofar as Faraday refers to science as "a continual correction of ignorance" (Jenkins 210) and treats the imagination as the source of "doubtful knowledge" (see above), he renders science and imagination mutually reinforcing.

Faraday goes on to say that such speculations are "useful in rendering the vague idea more clear for the time, giving it something like a definite shape, that it may be submitted to experiment and calculation; but they lead on, by deduction and correction, to the discovery of new phenomena, and so cause an increase and advance of real physical truth, which, unlike the hypothesis that led to it, becomes fundamental knowledge not subject to change" (*Experimental Researches* 2: 408).[90] What perhaps began as "delusive mists" that have escaped their proper bounds are now hypotheses, which themselves have no value until confirmed by experimental evidence, which transforms them into "real physical truth." Readers of Shelley recognize that "shape" grants these lines a provisional materiality, one based not on any ontological claim but rather on claims of intelligibility.

Faraday elaborates, "The lines of magnetic force have not as yet been affected in their qualities, i.e., nothing analogous to the polarization of a ray of light or heat has been impressed on them. A relation between them and the rays of light when polarized has been discovered; but it is not of such a nature as to give proof as yet, either that the lines of magnetic force have a separate existence, or they have not; though I think the facts are in favour of the former supposition" (3: 412). Physicality is tied to supposition, and, until Faraday has evidence that the lines of force have qualities that are affected and that they take place in time, lines of force must remain vectors of imagination.

Faraday elaborates, "It appears to me, that the outer forces at the poles can only have relation to each other by curved lines of force through the surrounding space; and I cannot conceive curved lines of force without the conditions of a physical existence in that intermediate space. If they exist, it is not by a succession of particles, as in the case of static electric induction, but by the condition of space free from such material particles" (*Experimental Researches* 3: 414). Even when he comes closest to making a physical claim, Faraday brackets the claim of physicality by appearance and by conception. The lines of magnetic forces are to be explained by "the condition of space," but what that means is not entirely clear.[91] Previously, he had warned that, "in numerous case of force acting at a distance, the philosopher has gradually learned that it is by no means sufficient to rest satisfied with the mere fact, and has therefore directed his attention to the manner in which the force is transmitted across the intervening space" (3: 408). Faraday's sense of the physical lines of force, then, means to supplement the idea of action at a distance and does so by shifting the attention from the actuality of the lines to understanding how the lines work across space. He thus argues that if he could prove whether lines of force require time, "it would show undeniably that a physical agency existed in the course of the line of force" (3: 409).

Temporality thus becomes a future arbiter of physicality, for he admits that "no relation of time to the lines of magnetic force has as yet been discovered" (*Experimental Researches* 3: 412). As expected, he then embarks on experiments that will help him show that lines of magnetic force do require time. He notes, for example, that "the simple disposition of the lines, as they are shown by iron particles, cannot as yet be brought into proof of such curvature, because they may be dependent upon the presence of these particles and their mutual attraction on each other and the magnets" (3: 412). Faraday, moreover, turns to imagination to render these lines physical, arguing, "If it be imagined for a moment, that the two polarities of the bar-magnet are in relation to each other, but whilst there is no external object to be acted upon they are related to each other through the magnet itself

. . . still it would follow, that upon the forces being determined externally, a change in the sum of the force both within and without the magnet should be caused" (2: 415). Only by imagining a relationality between the polarities does Faraday come up with a way of calculating a change in forces that would underscore their relation to time, and this relation proves their physicality.[92]

Faraday concludes this paper, speculating, "Whether it of necessity requires matter for its sustenation will depend upon what is understood by the term matter. If that is to be confined to ponderable or gravitating substances, then matter is not essential to the physical lines of magnetic force any more than to a ray of light or heat; but if in the assumption of an aether we admit it to be a species of matter, then the lines of force may depend upon some function of it" (*Experimental Researches* 3: 443). Imagination goes with matter when physicality demands the most careful speculation; magnetic lines are more readily understood as physical if we allow an assumption of imponderable matter like ether, a curious if capacious form of materiality that resists measurability.

As we have seen, for physicists and chemists, matter provided one of the most difficult subjects to distinguish between imagination and fact. As late as 1844, Faraday bemoaned "how little general theory of matter is known as fact & how much is assumption" ("Speculations"). Kant had dismissed the corpuscular theory of matter as *Phantasie*, and Faraday would concur. In "A Speculation touching Electric Conduction and the Nature of Matter," first published in the February 1844 issue of the *Philosophical Magazine* and later printed as the last paper in his *Experimental Researches* in 1844, suggesting a last-minute addition, Faraday argued that "the word atom, which can never be used without involving much that is purely hypothetical, is often intended to be used to express a simple fact; but good as the intention is, I have not yet found a mind that did habitually separate it from its accompanying temptations" (*Experimental Researches* 2: 285).[93] Here, Faraday rejects John Dalton's terms "definite proportions" because they "were not expressive enough, and did not say all that was in the mind of him who used the word atom in their stead; they did not express the hypothesis as well as the fact" (ibid.).[94] He later calls this an "extension of the atomic theory which chemists have imagined" (2: 287).

Part of the problem with corpuscularity is, what to make of the space between atoms, and does that space count as matter? Moreover, if action between contiguous particles were denied, then it would be necessary to credit space between the atoms to account for interactions between the particles (Harman 76). He queries, "For where is the least ground (except in a gratuitous assumption) for imagining a difference in kind between the nature of that space midway between

the centres of two contiguous atoms and any other spot between these centres? A difference in degree, or even in the nature of the power consistent with the law of continuity, I can admit, but the difference between a supposed little hard particle and the powers around it I cannot imagine" (*Experimental Researches* 2: 290). His theory of matter allowed it to be contiguous. He continues, "What thought remains on which to hang the imagination of an independent of the acknowledged forces?" (2: 291). Thought provides a basis for imagination to speculate on physicality. Forces become the essence of matter because they do not presume a nothing as its basis, but even forces must be bracketed by speculation, making whatever essence they have subject to doubt and revision.[95]

Because Faraday claimed to have been rescued from his imagination by facts, it is crucial to recognize that his later insistence upon force as the very essence of matter is, like Priestley's, a result of his conviction that force is the only thing we can empirically experience about matter, even though all we can see are force's effects. He argues in 1844, "We can know nothing about matter but its forces—nothing in the creation but the effect of these forces—further our sensations and perceptions are not fitted to carry us—all the rest which we may conceive we know is only imagination" ("Syllabus" F/4/J/4, page 22). Effect of forces is the only thing we can know, especially since effects are not necessarily equivalent to causes.

And yet if his empiricism was a key influence, so was his theology. Historian of science David Gooding has shown that Faraday needs an active, almost vital sense of force so that he can leave God in the universe.[96] Gooding explains that Faraday resisted understanding force as a mechanical equivalent to work because he conflated potentiality with exertion and the effects of those powers ("Mechanics versus Measurement" 11), and to think of force in terms of mere mechanism was fundamentally incompatible with his theology. Like his mentor, Humphry Davy, Faraday's search for a unity of the forces in the world stemmed from his conviction that a beneficent God worked through simplicity. In his early papers, he affirmed the identity of electricity and chemical affinity (Harman 34). In his Juvenile Lectures at the Royal Institution of 1859, Faraday took pains to demonstrate the convertibility of chemical force into electricity and electricity into magnetism, and his ultimate aim was to show the "universal correlation of the physical forces of matter" (*Forces* 87), one that spoke to the simplicity and elegance of the designed universe.

Thinking about matter in terms of force had one additional advantage for Faraday. Force not only allowed Faraday a way to conceptualize how the mind works but also a way of negotiating the relationship of the human mind to physics, giving them a common language. In his lecture "Observations on the Inertia of

the Mind," given at the City Philosophical Society on July 1, 1818, Faraday sought to get to the bottom of "apathy of the mind" ("Observations" 340).[97] After defining inertia as an "essential property of matter" (348), Faraday wonders whether it is a "never failing attendant on the mind" (348). He continues, 'I hope it is for as it seems to be in full force whenever the mind is passive I trust it is also in power when she is actively engaged" (348). He then mediates on the "disturbing forces" that interfere with inertia:

> The centripetal force, the force resulting from chemical action and that which originates in muscular exertion are at all times active in changing and varying the states induced by inertia, sometimes aiding, sometimes counteracting its effect. These are represented among intellectual beings by the sensations, perceptions, passions, and other mental influences which interfere (frequently so much to our inconvenience) in the dictates of our reason . . . So vanity, ambition, pride, interest, and a thousand other influences tend to make men redouble their efforts; and the effect is such, that what appeared at first an impassable barrier easily gives way before the increasing power opposed to it.[98]
>
> ("Observations" 350–51)

"Force" is such a useful term for Faraday because it enables him to bring together forces like centripetal and centrifugal force—which cannot be merely mechanical—with sensation, perception, passion, muscular force, and other mental influences.[99] Forces further allow human will and passion to interact with the physics of nature and, at times, to overcome them. And yet by labeling both industry and apathy forms of mental inertia, Faraday can think about them both as habits: "Both Idleness and Industry are habits and habits result from inertia" (352). In the same way that inertia is a force that seeks to maintain its state, habits are inertial, and so the key is to start off with the right habits because they are difficult to change. In the same way that physical forces require intervention or disruption, mental forces demand control capable of overcoming inertia. Faraday's position regarding change, then, was fundamentally conservative.

Faraday would return to the relationship between internal and external force in his diary.[100] While experimenting on various modes of electrical transmission on December 2, 1833, he noted, "Priestley was probably the first who put forth the view that Electricity is an important agent between mind and body in the animal system" (2: 177). Two weeks later, he considered how little electricity was necessary to effect frogs and mused, "How little required for mental Government" (2: 183). Although he was not convinced that "nervous fluid is only electricity," he supposed that "magnetism is a higher relation of force than electricity, so it may

well be imagined, that the nervous power may be of a still more exalted character, and yet within the reach of experiment" ("Annotated Offprints" F/3/E, entry 1792). Indeed, on the back of his manuscript notes for his 1835–36 Juvenile Lectures on Electricity, Faraday wrote, "First chem force is electricity is magnetism is heat is nervous energy or like it" ("Royal Institution Lectures" back of A34).

Romantic theories of matter thus undermine the notion of nature as an unchanging constant. The idea of nature as fixed is useful to a socially constructionist theory that works by moving entities from the category of nature to that of culture so that it can be changed. That nature was understood dynamically meant that it stood on the side of change instead of against it. Moreover, because thinking about the active forces in matter had consequences for how human beings are to act, the forces of matter resonated with imagination. On the one hand, the forces of nature can become human agency. This allows for a seamless integration of humanity and the environment, but at the expense of nature's force being annexed to mankind's. On the other hand, the difference between human force and matter's force is the ground for agency, an especially vexed ground, given that force was often granted an activeness of its own.

PERCY SHELLEY: IMAGINING THE DYNAMIC FORCES OF MATTER

I have argued that Romantic theories of matter ultimately made the synthesis of imagination and matter possible. Long understood to embody a tension between science and the imagination, Percy Shelley's 1820 "Letter to Maria Gisborne" offers a test case that allows me to first show how matter and the imagination are unified and then, second, to think about why this alleged tension has been so useful to Romantic criticism.[101] Don Reiman and Neil Fraistat, two of Shelley's most gifted editors, curiously remark that "running through [the poem] is a strong unifying theme contrasting mechanical and scientific knowledge with the magical powers of the imagination" (*Shelley's Poetry and Prose* 329). I contend that Shelley makes no such stark contrast. When matter is no longer assumed to embody presence and instead, through an interaction of forces, makes solidity matter's appearance, figurative language can no longer be credited with automatic skepticism about unity and presence because Romantic thought about matter is equally and already skeptical about forms of presence. If Shelley's detractors like F. R. Leavis complained of the poet's "weak grasp of the actual" (206), I want to underscore that critics have had an impoverished understanding of what Shelley thought of as actual. For instance, Shelley's critics have generally accepted that in 1812 when writing "On a Future State," the poet renounced materialism. He wrote,

"For when we use the words principle, power, cause, &c., we mean to express no real beings, but only to class under those terms a certain series of co-existing phenomena; but let it be supposed that this principle is a certain substance which escapes the observation of the chemist and the anatomist. It certainly may be; though it is sufficiently unphilosophical to allege the possibility of an opinion as proof of its truth" (Ingpen and Peck 6: 208–09). Far from a renunciation of materialism, Shelley insists that the principle *may be* a substance.[102] His concern is epistemology, not ontology; classification, but only as a way of thinking. What he objects to is the offering of an opinion as evidence. Moreover, in grouping terms like "principle," "power," and "cause" under phenomenality, Shelley maintains his interest in epistemology by arguing for a way of thinking about materiality that resists equating appearance with reality. As I will demonstrate here, Shelley considers matter in terms of forces, because forces are what give matter whatever phenomenality matter has for us, and, in thinking about matter in terms of forces, Shelley also transforms perdurability into phenomena that mask the inevitability of change (thus his use of "brief omnipotence" to refer to Jupiter's reign in *Prometheus Unbound*). Forces furthermore enable him to think of the world in terms of multiple centers of interacting forces that downplays the role of the self. The alleged tension between the creative imagination and science has served to make creativity the province of the arts, not the sciences, with the result that theories of matter have not been seen as essentially creative and, thus, a response to concepts of matter that resist change by bringing matter in line with change.[103]

Like Anna Laetitia Barbauld's "An Inventory of the Furniture in Dr. Priestley's Study," Shelley's "Letter to Maria Gisborne" centers on Henry Reveley's study, filled with scientific and engineering instruments. Shelley insists on the geographic gap between Henry and him, Henry being in London, and Shelley in Italy. However, Shelley's thinking about matter in fact ultimately allows us to reconcile science and poetry, not to mention matter and the imagination. In fact, in response to Henry Reveley's Friday, November 12, 1819, description of the casting of the steam cylinder and air pump that Shelley had helped to pay for, Shelley wrote, "Your volcanic description of the birth of the Cylinder is very characteristic of both you & of it. One might imagine God when he made the earth, & saw the granite mountains & flinty promountories [*sic*] flow into their craggy forms, & the splendor of their fusion filling millions of miles of the void space, like the tail of a comet" (Jones 2: 158).[104] In the above letter, Shelley's imagination made no such division between science and art, and in fact Reveley's casting of the cylinder immediately prompts the poet's imagination to generate metaphors for the creation of the world, thereby connecting even godly engineering, human engineering, and poetic mak-

ing. Henry had come up with an idea to create a steamboat to ferry passengers between Leghorn, Genoa, and Marseilles (Jones, *Maria Gisborne* 7).

Let's begin our brief examination of "The Letter to Maria Gisborne" with Shelley's fascination with quicksilver, or mercury.[105] As liquid metal, it symbolizes "Proteus transformed to metal" (line 45). Humphry Davy had in his 1812 *Elements of Chemistry* noted mercury's ability to "combine with most of the common metals" and warned of its volatility (*Works* 4: 330). Already harnessed for use in scientific instruments, quicksilver precedes Shelley's catalogue of "scientific instruments" (lines 82–83), and thus mercury literally has a unifying function, drawing together scientific instruments and the poet's measured "catalogiz[ing] . . . verse" (line 55). Shelley recognizes that matter embodies similar Protean possibilities as figurative language, so much so that "Tubal Cain" (line 51), regularly cited in the period as the first chemist, and all his brood, are "puzzled" by the various shapes of wood and brass in Reveley's study. Boerhaave's *Elements of Chemistry*, for instance, named Tubal Cain as a cultivator of the "art of metallurgy," a branch of chemistry (1: 5). Boerhaave not only treated chemistry as a practical art, not science, thereby closing the gap between Reveley and Shelley, but he also noted that the etymology of "chemistry" alludes to mystery, the occult, and magic (1: 5). Shelley's reference to books of old chemistry (line 99) further reminds us that chemistry begins with the study of alchemy, the transmutation of baser metals into gold, which in turn reminds us that the history of chemistry and of magic are intertwined, not separate.[106] Once again the magic powers of imagination belong to science and to art, even as chemistry belonged to both. Like Henry, who is working on the steamboat, Shelley floats a paper boat in the ocean of mercury. If matter has all the plasticity of figurative language, then Shelley has no need of figures to undermine the presence within matter, and Shelley's ability to deconstruct matter and language here through scientific knowledge prevents creativity from being the lone province of the arts. Shelley writes:

> And in this bowl of quicksilver—for I
> Yield to the impulse of an infancy
> Outlasting manhood—I have made to float
> A rude idealism of a paper boat—
> A hollow screw with cogs—Henry will know
> The thing I mean and laugh at me (lines 74–77)

Not only does Henry's making prompt Shelley's making/engineering of a paper boat, but also these acts of construction prompt the making of the poem. The "hollow screw with cogs" refers to Archimedes, mentioned in line 16, who in-

vented a screw that scoops up a volume of water. Thus, Shelley weaves a genealogy of making from Archimedes to Henry to himself, one that disperses action along the continuum of history. Like Archimedes, who invented the screw to pump out ships and keep them afloat, Shelley floats his idealism on mercury, known for its healing powers. In comparing himself to this bowl of quicksilver, and in connecting the protean nature of this metal to the childish, even infantile, impulse that he allows to drive him (the verb "yield" insists on deliberation, as does its trochaic substitution), Shelley juxtaposes quicksilver's affinity to other elements to his intentional state, further preventing any separation of imagination and science. One might even say that the quicksilver prompts the poet to create the "I" who yields as a virtual epiphenomenon out of an impulse that is close to the physics of action. At the same time as the genealogy across time insists, this "I" is just a node of action, and thus selfhood is limited.

Shelley further joins together the forces of moonlight (lines 255–56) and his thoughts. "I recall / My thoughts," Shelley intones, "and bid you look upon the night. / As water does a sponge, so the moonlight / Fills the void, hollow, universal air—" (lines 253–56). Moonlight fills the void, as water fills the sponge and thoughts fill the air. Yet in framing the act of looking in terms of simile, Shelley's emphasis is on apprehension, not ontology. Moreover, the poet's thoughts fill the "universal air," and the very universality of that air forges an interactivity between poet and engineer. "Universal air," moreover, recalls Newton's ether, both the vehicle through which God's forces acted from a distance and one key limitation of the atomic theory of matter.[107] But Shelley's theory of dynamic matter has neither need of an ether nor of a God behind it because there is only continuous interaction of matter. Shelley thereby both gives thought material form and allows it to interact with the things of this world since it shares a dynamic material force. To highlight Henry's and the poet's essential unity despite the geographic distance, Shelley concludes the previous verse paragraph with a list of the people "you and I know in London" (line 253).

This image of thought as a force like moonlight prepares the way for Shelley's self-description as "some weird Archimage sit I, / Plotting dark spells, and devilish enginery, / the self-impelling steam-wheels of the mind" (lines 106–08). Spenser, we recall, linked Archimago to science: "For by his mightie science he could take / As many forms and shapes in seeming wise, / As ever Proteus to himselfe could make" (book I, canto II, lines 11–13). Archimage understands matter in terms of forms and appearances—hence he embodies "image"—and thus unites mercury, Proteus, and science, and perhaps even the self-impelling quality of the poet's mind insofar as "Proteus to himself could make." Self-impelling indeed: Joanna

Picciotto argues that Spenser's Archimage functions as a trope of iconoclasm, itself generating narratives to fix the problem of signs hoping to be signifieds (19). In this way, the poet produces representations always subject to self-correction, much in the way that a scientific method tries to redeem itself from error. Far from being the opposite of poetry, physics gives Shelley ways of thinking about what thought actually was; and the fact that Reveley's engine works through steam collapses the gap between the poet's mind and machine, since, as John Tresch argues, steam engines look self-propelled, as if alive (12).[108] When the poet refers to Coleridge's mind in terms of an "Intense irradiation of a mind/Which, with its own internal lightning blind" (lines 204–05), he once again uses metaphors associated with scientific force to think about thoughts and their physical means of influence.

Irradiation is the power of giving off rays, and this recalls the forces of moonlight entering the atmosphere. Unlike Coleridge's thoughts, which are reduced to a kind of mind-blinding internal lightning, Shelley makes his thoughts like ether and light, illuminating the world. To underscore the union of Shelley and Reveley, he describes the "communion" (line 145) of the two of them, and Shelley recalls how Henry "listened to some uninterrupted flow/Of visionary rhyme, in joy and pain/Struck from the inmost fountains of my brain" (lines 168–70). Shelley's enjambment allows Henry's listening an immediate connection to the poet's brain through rhyme, and along with them the "you" and "my" become a "we" (lines 167, 169, and 170). The bottom line is that there is no gap between science and imagination,[109] and the poet's turn to force additionally allows him to unify thought and matter insofar as his brain is a self-impelling engine whose light irradiates the earth. Shelley knew that alchemy and magic were furthermore an undisputable part of chemistry's past—even the great Newton was an alchemist—and Shelley limits neither creativity nor magic to the artistic imagination.[110]

In *Prometheus Unbound*, Shelley continues to describe matter in terms of the forces within it, not in terms of its hardness or pedurability or extension.[111] Matter thus participates in change instead of being an obstacle to it. Earth is, after all, one of the major characters. For the poet, matter is a force that acts in the world: the poet's repeated use of "whirlwind" (lines 44 and 66) to describe matter underscores his dynamic understanding of it. Shelley emphasizes this dynamic understanding through his insistent use of "radiant" to modify forms of matter—which Humphry Davy defined in 1812 as a fourth state of matter, and which he thought was imponderable or immeasurable—thus giving them an equivocal materiality.[112] All bodies, many chemists and physicists thought, "radiate" light and heat, and sometimes light without heat. Newton thought that the ability to radiate heat or light depended upon the exact arrangement of particles in matter. Asia de-

scribes the "radiant looks of unbewailing flowers" (II.4.16), the spirit of the hour describes the "radiant forms" of the earth (III.iv.155), and Ione mentions the "radiant air" (IV.239). But does the source of radiating power come from the sun, from an undulating elastic substance (Davy, *Works* 4: 157), or from the matter itself? The very category of radiant matter frustrates an easy answer because it acts; moreover, radiant matter implies a matter whose very essence is the dynamic force within it.

Humphry Davy thought that, in radiant matter, "the particles act almost independently of the common laws of attraction" (*Works* 4: 157–64; Grabo 110), indicating his sense of heat and light as vibrations in the particles that made up the body. The category therefore fudges the source of the radiance and grants matter a kind of strategic activity; Shelley suggests the active forces in matter are both the source of the rays and the reason why we can know matter only as form or appearance. No wonder why radiant matter had been the subject of much imagination: Davy noted that scientists had "imagined" an "imponderable substance capable of producing light" existing in "inflammable bodies" (*Works* 4: 163). He did think that "the calorific particles of terrestrial bodies . . . may be imagined as larger than those of the sun" (4: 164).

Within the drama, Prometheus identifies the source of matter's radiance as hovering between mind and reality. When imagining the cave in which he and Asia will be reunited, Prometheus insists:

> And lovely apparitions dim at first,
> Then radiant—as the mind, arising bright
> From the embrace of beauty (whence the forms
> Of which they are the phantoms) casts on them
> The gathered rays which are the reality— (III.iii.49–53)

These lines ostensibly frame the mind as the source of radiance, as well they should insofar as Prometheus is imagining this radiance. And yet, the grammatical ambiguity of the first two lines confuses the actual source, as does Shelley's invocation of "the reality." Apparitions are initially the grammatical subject of the lines, but these are displaced by the mind, which does the casting. And yet if the "gathered rays" are the reality, what is apparition, and what is form, and phantom? Shelley's framing of the mind within dashes further supports a separation of apparition and mind, as does the additional ambiguity of "gathered." Do the rays gather by themselves, or are they gathered by mind into radiance? Davy notes that optics was one of the main ways to study radiant or electrified matter because it was

speculated that the undulations of the ethereal substance beneath radiant matter "constitute the sensations of vision" (*Works* 4: 157). It turns out, then, that "apparition" and "rays" point to the same reality of electrified or radiant matter. Stuart Curran argues that Prometheus's forgiveness of Jupiter enables the entire cosmos to turn because the recalling of the curse ends the cycles of violence (96). The turn of the cosmos can likewise enhance the radiance of the mind, and this interaction is through the medium of the rays. When Shelley describes the rays as "lovely," he associates them with love, and the adverb aligns them with active force.

In any case, Shelley's insistence on the phenomenality of matter itself speaks to the forces that inform it, even as mind and matter now have a possible means of interaction.[113] Shelley's love of such terms as "inter-transpicuous" and "interpenetrates" to describe matter, moreover, insists on the spaces within matter that provide homes to the various electromagnetic forces of the universe.[114] Both the sun and moon are porous: sunlight has pores, and the moon insists "love and odour and deep melody" work "Through me, through me" (IV.i.331). Impenetrability thus is at best a form of matter's appearance, a consequence of the forces. Here, of course, Shelley's insistent "throughs" put to bed the alleged impenetrability of matter even as "home" resists ontologizing the forces as presence since it is a mere container. This force takes on many forms: Shelley's preface casts Prometheus as "the patient opposition to omnipotent force" (Reiman and Fraistat 207): we learn as the play unfolds that Jupiter's force only "seems Omnipotent" (IV.572).[115] Shelley's universe teems with other forces: electricity, magnetism, light, ether, and—even and especially, understood most literally as—the planetary attraction of Venus for other planets.[116] Prometheus has to learn that those forces are capable of countering Jupiter's force, just as Jupiter must learn not to believe in his own omnipotence, since his force is both brief and hardly the only game in town. In his early essay "On Love," Shelley claims that love "is that powerful attraction towards all that we conceive or fear or hope beyond ourselves when we find within our own thoughts the chasm of an insufficient void and seek to awaken in all things that are a community with what we experience within ourselves" (Reiman and Fraistat 503). Curiously, "love" straddles the internal and external: now an external force, now a state of mind or emotion. It is an attraction whose force we first encounter when we experience the void within our own thoughts, and thus it seems external to us. Nonetheless, since this void prompts us to awaken a wider community, the force of love is simultaneously part of us. When love is considered a force, it can challenge tyranny, and Shelley's figures love as having eyes that are "veiled not" (IV.i.92). Shelley also links love to a force when he describes it as "Forcing Life's

wildest shores to own its sovereign sway" (IV.411). His initial trochaic substitution enacts that very force.[117] By making love own its own sovereignty, Shelley reminds us that love without power and ownership is feckless.

Equating the forces of attraction with love allows Shelley, in keeping with scientific sensibility, not to assume that the material and moral are separate entities. Like his friend Humphry Davy, speaking as Philalethes in his posthumously published *Consolations in Travel*, Shelley would anticipate Davy's speculation that "love [i]s the creative principle in the material world" (*Works* 9: 346).[118] Philalethes sees "in all the powers of matter the instruments of the deity" (ibid.). Unlike Philalethes, who connects love to the divine and limits it to a "divine attribute" (ibid.) so he does not have to believe in a materialism that endows matter with "irritability, ripening into sensibility" (9: 345–46), for Shelley the material is spiritual. Panthea explains to her sister, Asia, that "Love, like the atmosphere / of the sun's fire filling the living world, / Burst from thee, and illumined Earth and Heaven" (II.v.26–28). Love is like fire, sun, heat, and light, where "like" functions not so much as a form of linguistic deferral but rather as an attractive spatial force linking all things. The simile marks relationality and, more specifically, relationality as the closest possible claim to ontology. Quite literally so: love is the source of radiance, electrifying matter. Like Newtonian ether, and like the Higgs boson, the field that explains why matter has mass, Shelley's love surrounds, interpenetrates, and fills the world (I.i.660). It fills receptive subjects, at once animating subjectivity with objective force.[119] Crucially, however, the mere presence of forces does not dictate triumph: one obstacle is that it must be perceived, felt, and understood to have effect on humans; it must also earn its subjectivity by being taken in, and owned, as part of the self, only then to be redispersed through the world.

Read with an emphasis on Shelley's understanding of matter as the product of active forces, Panthea's famous vision of "ten thousand orbs involving and involved" no longer serves merely as a feckless visionary symbol but instead embodies the world, of which Prometheus is only an inextricable part. Shelley's insistence upon "involved" and "involving" unifies subject and environment, making escapism impossible: one has no choice but to remain involved. Although Panthea describes it as "solid as chrystal" (IV.239), Shelley comments that "through all its mass / Flow, as through empty space, music and light" (IV.239–40). "Chrystal" perhaps also alludes to the theory that even minerals were informed by a principle of organization.[120] The poet's emphasis on flow underscores his dynamic understanding of matter, whereby solidity is the outcome of those forces. The spheres are further

> Yet each intertranspicuous, and they whirl
> Over each other with a thousand motions
> Upon a thousand sightless axles spinning
> And with the force of self-destroying swiftness,
> Intensely, slowly, solemnly roll on— (IV.246–50)

All of this simultaneous spinning intensifies forces that continually destroy each other, but this destruction both frustrates tyranny and enacts what earth calls "the animation of delight" (IV.321). Against a corpuscular version of matter that demands one center of force, this universe has multiple centers that demand an ecological understanding of force (it radiates in multiple directions). Matter is continually changing, if slowly, and when Panthea twice calls these forces light, she insists on how love and light penetrate matter and thus change its perdurable appearance. The last line's three adverbs remind us that what looks like a noun is in actuality a verb even as love's revolutionary attractions and repulsions dynamically pit continuity—they "roll on"—against discontinuity (they are "self-destroying"). In this view, love is revolution, and thus the hour of love cannot replace the hour of revolution, as Earl Wasserman influentially argued (*Shelley* 325), because they are two sides of the same thing.

If force helps Shelley both to understand the appearance of matter and to think of it as analogous to the mind so the two can interact, it also provides him with a key analogy for understanding the relation between imagination and matter. And yet, no mere figure, analogy functions for Shelley as an embodiment of both the principle of attraction between discrete entities (Bruhn, "Shelley's Theory of Mind" 403) and a principle of mind, but one that is open to development (382, 406).[121] Analogy thus offers evidence of a probable material interconnectedness between seemingly different things. Shelley in fact explicitly compares the attractive forces within the principle of psychological association to those of gravity. He argues imagination may be considered

> as mind combining the elements of thought itself. It has been termed the power of association; and on an accurate anatomy of the functions of the mind, it would be difficult to assign any other origin to the mass of what we perceive and know than this power. Association is, however, rather a law according to which this power is exerted than the power itself; in the same manner as gravitation is the passive expression of the reciprocal tendency of heavy bodies toward their respective centres. Were these bodies conscious of such a tendency, the name which they would assign to that consciousness would express the cause of gravitation; and it were a vain inquiry as to what might be the cause of that cause.

> Association bears the same relation to imagination as a mode to a source of action . . . (Ingpen and Peck 7: 107)

Imagination is the source of combinations of thought, and those combinations are bound by love. Similarly, matter is beholden to the law of gravitational force and thus also bound by love. Demogorgon in fact connects gravity to love when he describes the earth's orbit in terms of "the Love, which paves thy path along the skies" (IV.522). Here, the forces of attraction pave the planetary orbit, as if an orbit can be paved in the sky. In the same way that matter needs gravity, Shelley argues that the imagination is bound by the law of association, which itself recognizes reciprocal attractions between distinct entities.[122] Once again dynamism asserts multiple centers of action that interact, thereby insisting upon ecology.

Consciousness, however, imposes this key difference from matter: it makes association a law, not the power itself, in the same way that gravitation is a passive expression of reciprocal attraction. If bodies could be conscious of such a tendency, then this consciousness would provide the name of the force that expresses the cause of gravitation. Gravitation as force looks like a cause, but that is really a painted veil with another cause behind it. The poet's distinction between a law and a power captures the ambiguity of force insofar as force both attracts and impels, bringing out a distinction between what is self-willed and what is coerced. Although framing association as a law would seem to demand coercion even of consciousness, the actual forms of association are not dictated, but rather the tendency to attraction is. That Shelley thinks there is a cause behind the cause of gravitation suggests that he is looking for an active cause behind gravity, and this active cause is proximate to an intentional state or emotion like love. Where Newton hypothesized God, Shelley argues that this force is what we know as love: "There is no attribute of God which is not either borrowed from the passions and powers of the human mind, or which is not a negation" (Ingpen and Peck 6: 54). To slightly modify Sharon Ruston: that the world teems with forces of attraction "creates the necessary environment in which life can flourish and regenerate itself" (*Shelley and Vitality* 125). Despite Jupiter's tyranny, matter paradoxically through force retains the potential to encourage both love and freedom. Once Prometheus recalls his curse, the Chorus of Spirits chants, "And beyond our eyes / The human love lies / Which makes all it gazes on, Paradise" (IV.126–28). Human love is both objective, in that it exists beyond the eyes, and subjective, hinting that the beyond is also internal. And yet the eyes embody that love, which in turn makes the visible world paradise, and, fittingly, the word "paradise" becomes a pun on the pair of eyes that is love that makes the paradise.

Force provided Shelley with a useful way of distinguishing between the degrees of influence of different kinds of thoughts. In his "Speculations on Metaphysics," Shelley argued, "Thoughts, or ideas, or notions, call them what you will, differ from each other, not in kind, but in force" (Ingpen and Peck 7: 59). He elaborates, "It has commonly been supposed that those distinct thoughts which affect a number of persons, at regular intervals, during the passage of a multitude of other thoughts, which are called real, or external objects, are totally different in kind from those which affect only a few persons, and which recur at irregular intervals, and are usually more obscure and indistinct, such as hallucinations, dreams, and the ideas of madness" (ibid.). Why does Shelley eliminate differences of kind when thinking about thoughts and notions and in their place put differences of degree of force? He could not have known what we know now: that the mind processes virtual reality through the same neural mechanisms as it processes reality. However, by making the key differences in degrees of force, Shelley has an explanation for why we act upon one idea or another, and, by eliminating differences of kind between these various thoughts, Shelley grants imagination the same kind of force as a perception. Imagination, thus, is both creative and reproductive, and this difference is no longer one of kind: the end result is an ultimate monism of force that frames the perdurability of matter as appearance whose essence is love.

Force thus enables Shelley to allow mind to interact with matter; moreover, he thereby endows the mind with a tendency to such an interaction. Force produces motion, and motion, following Kant, is what allows us to encounter matter in the sense of perceiving it and in the sense of providing the basis for the hardness we think we feel when we come into contact with it. That basis is the forces of attraction and repulsion. His understanding of forces may have come in part from his reading of the astronomer William Herschel, who described the heavens "yield[ing] to my light and power, resolv[ing] into stars" (*Account* 5–6).[123] Herschel thus proudly announces the invention of a superior telescope that could subject the forces of the stars, and the ambiguity of his verb "resolve" allows perception to shape or, if "resolve" is taken as the precursor to action, precipitate the thing. The resolution of his telescope allows the stars themselves to resolve, and this description perhaps influenced Shelley's presentation of Asia starring into Panthea's eyes: Is she looking at the vision already there, or does she bring it into focus so that it can be seen (Sperry, *Shelley's Major Verse* 97)? To the extent that the role of the visionary is perceptive, perception now is partly creative; the twin senses of "resolve" allow the object to shape the viewer just as much as the viewer shapes the object, leveling the power distinctions between them.

Together with the mind, the forces of the universe create a "chain of linked thought, of love, and might/to be divided not" (IV.395). Shelley's line break reminds us that a lack of division is a future experience to be enacted by the reader. This chain further "compels the elements with adamantine stress" (IV.396), and here I simply point out that he shifts "adamantine" from the res extensa of matter to the forces within it: it is the stress that compels the elements to unify, and thus this stress is matter's very formal if shifting essence. Such essence remains appearance, and form is what the human mind can know about things.

Shelley's belief in the interplay between the force of imagination and the forces of matter may owe another debt to Herschel. In his paper *On the Nature and Construction of the Sun and Fixed Stars*, the astronomer warns that although the spots of the moon may look like cavities, they are in fact mountains. He writes, "As soon as, by the force of the imagination, you drive away the fallacious appearance of a concave moon, you restore the mountains to their protuberance" (10). Herschel grants imagination force, even as he describes the forces that shape the universe. More critically, instead of thinking about the powers of imagination as misleading perception, he credits imagination with being able to see the moon properly beyond the optical illusion. The imagination is what will allow people to "drive away the fallacious appearance" (ibid.): Herschel adopts it to make a scientific observation, because only the imagination can factor out the optical illusion from sight.

Such an animated understanding of matter is fully corroborated by Shelley's speaker, Eusebes, in the poet's "A Refutation of Deism." Eusebes, a believer in divine revelation, confronts Theosophus, who justifies his belief in God through deism and the argument by design, which claims that the intricacy of the universe demands an intelligent designer. Eusebes argues, "Matter, such as we behold it is not inert. It is infinitely active and subtile. Light, electricity and magnetism are fluids not surpassed by thought itself in tenuity and activity; like thought they are sometimes the cause and sometimes the effect of motion; and, distinct as they are from every other class of substances, with which we are acquainted, seem to possess equal claims with thought to the unmeaning distinction of immateriality" (Ingpen and Peck 6: 50). Here force unites things and thought. In *Prometheus Unbound*, he refers to the fluids of light, electricity, and magnetism as forces (IV.249). In the "Refutation," given that Shelley is refuting deism, he is more aligned with Eusebes than with Theosophus. For our purposes here, this quotation supports the fact that Shelley seriously thought of matter in terms of forces and that he analogized the subtlety of certain kinds of matter like electricity and magnetism with thought so that thought might have influence upon the world.

But we cannot lose sight of Shelley's immediate goal in his essay. The animation of matter and the linking of thought with matter undermine deism because, if the forces within these kinds of subtle matter are like thought, then the hypothesis of a designer is superfluous. However, Shelley's own atheism prevents him from siding completely with Eusebes, who turns to revelation to prove God. At issue here is what the activeness of matter means. Does the activity of matter merely disprove deism? Does the failure of the argument by design prove revelation, as Eusebes hopes? For Shelley the activity of forces in the universe, the force of attraction, is love, and love is electrical. As early as 1806, Davy proposed that a "particular electric charge was an intrinsic, internal property of matter and that two bodies formed a compound only if their internal charges were of opposite qualities" (Goodstein 7). In "On Love," Shelley defines it as "that powerful attraction towards all that we conceive, or fear, or hope beyond ourselves" (Ingpen and Peck 6: 201). Love is what attracts us to things beyond ourselves so that we can compensate for the void that is the self. In claiming that love is what we turn to when we cannot deal with an insufficient void, he refutes the need for the revelation of God, since human love alone ideally provides a sufficient alternative to the void.

Shelley stresses the activeness of matter, and his attention to its activeness disturbs various frameworks for thinking about the world. Active forces disturb necessity because both the location of any particles of matter is not easily predictable and the multiple centers of force make calculating impact difficult at best.[124] To wit, Shelley describes the "form of love" as "scattering the liquid joy of life" (I.763, 766). Active forces further trouble any neat division between idealism and empiricism, as we have already seen with Shelley's interest in radiant matter. He likewise describes emotion as a force that "attracts, impels" (II.ii.51), and thus it is not clear whether emotion belongs to the universe or to the individual subject. The work of the subject is to make the motion behind emotion into emotion. This activeness exceeds the subject/object binary even as it surpasses mechanism with a kind of vitality. Bruno Latour has argued that actions[125] exceed their actors, and I would like to borrow from his sense that we need a way of talking about how objects act and how actions exceed their subjects (*Pandora's Hope* 146–51). Prometheus does not initially know that his curse is a key source of Jupiter's power, and Jupiter naïvely thinks that the forces of the universe are entirely and forever under his command. The forces of matter are thus resistant to any singular control, and though they are subject to the laws of nature, those laws cannot be mistaken for their powers. This gap between laws and powers frustrates determinism. This multitude of forces, moreover, continually seeks equality, and the attractions of sympathetic love are what make this seeking perpetual.[126]

Shelley's dynamic understanding of matter, however, raises both the problem of coercion and the bête noir of mechanism. Are human beings merely puppets whose strings are controlled by the forces of nature? Certainly, those forces had undeniable bodily and emotional impact. In a letter to Leigh Hunt announcing his and Mary's arrival at Calais in "good spirits," Shelley commented that "motion has always this effect on the blood, even when the mind knows that there are causes for dejection" (Jones 2: 458). Because force automatically invites the suggestion of tyranny, Shelley is on guard against a version of force that would make it a colonizing power even as he is aware that love must have power to have influence in the world. The relationship of analogy, therefore, allows for resemblance and difference, and in that way force can be a law but not a coercion, insofar as consciousness can attend to the forces it chooses to attend to and the difference foregrounded in analogy's refusal of synthesis prevents a kind of totalitarian unification. That Shelley both constructs an analogy between imagination and matter and at the same time stipulates that analogy functions as a mental law of sympathetic attraction between different entities enables him to essentialize an attractive force between the two without necessitating any particular outcome. The law of analogy is not the power itself; it is the source of mental action without predicting the mode of that action. Because analogy stipulates both a relationship and a difference—otherwise the two things compared would form an identity—analogy allows the force of attraction to make allowances for differences, and these differences are the very means to prevent solipsism and colonization and a return to Jupiter's tyranny.

The physics and chemistry of force not only influences the structure, machinery, and ideas of *Prometheus Unbound*, but they also reinforce the rhetorical goals that drive the drama. In his preface, Shelley announces that the "cloud of mind is discharging its collected lightning, and the equilibrium between institutions and opinions is now restoring, or is about to be restored" (Reiman and Fraistat 208). Earth explains that we fail to see these restorations because the grave obscures "the shadows of all forms that think and live," especially what she calls "light imaginings of men" (I.200), which, when contracted, becomes lightning. This contraction posits a shared electrical materiality between imagination and lightning. Davy wrote, "Electricity as chemical agent, may be considered not only as directly producing an infinite variety of changes, but likewise as influencing almost all which take [*sic*] place" (*Consolations* 9: 376). Although Jupiter had used lightning and thunder to enchain Prometheus, Shelley warns that it will not be so contained. At the very moment that electrical and magnetic lecturers fashioned their expertise by the control they had over such natural forces (Fara, *Sympathetic At-*

tractions 65), Shelley limits control even as he defines mind as the ultimate source of Promethean fire. The poet further alludes to the principle of conservation of electrical charge, the very principle that Benjamin Franklin exploited to tame electricity.[127] This principle demands that charges here must be discharged there and the account balanced: the larger implication is that the universe has a logic, balance, and symmetry to it. The conservation of charge has implications for the poet's ideal of equality, and, as Jerry Hogle has argued, Shelley is not so much interested in a blanket leveling of differences as he is in calculating "how much interplay is going on at one time between givers and receivers" (233). The degree of interplay is his central gauge of enlightenment, and the shift from corpuscles to dynamism not only makes this interplay cosmically possible but also makes possibility itself possible. Dynamism substitutes a network of relationality between forces for the necessity of immediate contact between atoms in order for action to take place.

Shelley thus treats opinion and institution as if they were electrical poles, which allows him to understand the relation between mind/opinion and matter/institution in terms of an economy whereby any discharge of opinion must entail an equally compensatory consequence, though the form of that consequence cannot be predicted. Here he may be alluding to Davy's use of the galvanic battery, which split compounds by drawing their elements to the positive and negative poles, and thus allowed Davy to isolate new forms of matter in 1807 like potassium and sodium, and barium and calcium. To the extent that Shelley frames institutions as contingent upon opinion—he applauds the "awakening of the public mind which shook to dust the oldest . . . form of the Christian Religion" (Reiman and Fraistat 208)—opinion/mind shapes or destroys institutions. The principle of the conservation of charge, then, allows him to think of ideas and thoughts as Promethean electrical charges with consequence but without known outcomes, since all that we can know is that the charges and discharges must balance. In that way, the electrical attractions of matter can interact with the attractions of the imagination. Electrical attraction, moreover, is both fundamental and necessary to matter itself, for, without it, matter would fly apart. In the same way that electrical charges seek equilibrium, enlightened human beings repeatedly choose to transfer the individual desire for equality to all beings.

Priestley worried about how the soul might engage the body if one were immaterial and the other material; Shelley thinks about force as having a special, subtle kind of materiality, one that transfers from matter to spirit. He even invents a term like "inter-transpicuous" to describe its necessary interrelationality. Like Davy, who sought to unify heat, light, electricity, and matter into one single force,

Shelley sees these forces as versions of each other, versions as he later puts it that will inspire "difference sweet where discord cannot be" (III.iii.39). Where difference within the various forms of material forces—electricity, magnetism, love, effort, will—can be and eventually are harmonized into unity, Shelley's insistence upon difference without discord explicitly does not allow that unity to eliminate difference, just discord. That this difference is owing not to language but rather to matter allows difference to remain more than a decentering. It becomes a harmony, a place where different notes all have their place. Earth refers to man as "one harmonious soul of many a soul" and later makes clear that this soul includes "his Will, with all mean passions" (IV.i.400, 406). Once again equality gets rid of differences at its own peril; who would choose a monotone over harmony? In insisting upon difference, Shelley's version of matter, thus, turns to harmony to resist both tyranny and logocentrism.

With this in mind we can now examine Shelley's declared purpose in *Prometheus Unbound*: "simply to familiarize the highly-refined imagination of the more select classes of poetical readers with the beautiful idealisms of moral excellence" (Reiman and Fraistat 209). The idea is to "familiarize" readers' imaginations with examples that he hopes will quite literally be attractive without being coercive. Think here of how the imitation of virtue in the "Defence of Poetry" gradually leads to possible identification with it. The poet's declared distaste for didacticism allows him to renounce coercion, and in fact he insists, "It is a mistake to suppose that I dedicate my poetical compositions solely to the direct enforcement of reform" (ibid.). Given that he frames Prometheus as the opposition to Jupiter's force, that he is aware that such forces must come to an equilibrium, his denial of "direct enforcement" nonetheless captures the necessary but unpredictable impact of the force of his writing, insofar as it does not eschew an indirection that invites, but cannot impose upon, the participation of the reader's imagination.

As I will show, Shelley allows for the development of humanity's sensitivity to the forces of attraction by showing that moral interactions lead to happiness, partly because selfishness allows kindness to be felt as reproach (I.393). If one is initially innately attracted to many things, one learns how to respond to the right attractions because the right attractions provide happiness. Prometheus himself initially only sees and feels Jupiter's force—"the falsehood and force of Him who reigns" (I.127)—but, as he forgives, he learns to feel and allow himself to be compelled by the force of love. His Torturer, by contrast, arms himself "with the strange might of unimagined pains" (I.366), making him oblivious to empathy and thus any forces of attraction. Thus, when Prometheus chooses to withdraw his curse, he chooses to allow "Love [to]/Burst in like light on caves cloven by the

thunderball" (IV.354–55). Shelley's trochaic substitution at the start of the line signals intent as it disrupts the habitual accentual force of the line. Prompted by Prometheus, love comes to fill the void annihilation, and it takes the form of lightning and thunder, smashing the caves open and instilling light over darkness.

Within *Prometheus Unbound*, Asia asks Demogorgon, who made all the universe contains—"thought, passion, reason, will,/Imagination" (II.iv.10–11)? The editors of the Norton *Shelley* warn readers that "the metaphysical implication of Asia's statement is that all the universe is made up of mental activities, yet this—like Asia's other assertions—is neither confirmed nor denied by Demogorgon and should be seen as a useful myth rather than a declaration of Shelley's beliefs about reality" (Reiman and Fraistat 247n8). While I agree that one should not assume that Asia stands for Shelley, I think that "myth" neither takes seriously the poet's complex understanding of matter nor understands the ways in which "force" works to bridge imagination and matter while recognizing their differences. The components of mind populate the universe, and they do so because it is mind that recognizes that forces are behind the solidity of matter, and because it is mind that knows it has an analogous force to love, as captured in Shelley's depiction of mental charges that can oppose the forces of nature.

Demogorgon apostrophizes "ye elemental Genii, who have homes/From man's high mind even to the central stone/Of sullen lead, from Heaven's star-fretted domes/To the dull weed dome sea-worm battens on—" (IV.539–42). Even as Humphry Davy struggled to decompose matter into its constituent elements with Volta's battery, Shelley makes "element" into an adjectival modifier of genii, not a noun. The lines end with a reference to iodine, an element Davy named after its violet color. Those animating spirits/forces are elemental insofar as the poet grants them "homes" in everything ranging from "man's high mind" to "stone/of lead"; matter and mind are linked by force, and the enjambed line breaks the monolithic stone of lead to show the interstices where force lurks. Perdurability is once again the home of forces, and it is not to be mistaken for the identity of matter. The choice of "home" is particularly apt insofar as forces make their home in the interstices of matter, but to reside in a place is not the same thing as to be that place. In this view, homes are Shelley's anticipation of our concept of supervenience. That forces are at home in matter but do not constitute matter allows Shelley to think of materiality as porous and continually changing, but ultimately unknowable, and therefore necessarily imagined. To wit, even Earth pronounces her own suffusion with force. She is "with love and odour and deep melody/Through me, through me!—" (IV.330–31). Here, Shelley's medial caesura in the final line testifies to that infusion.

The continually attractive powers of love further demand that individuals seek community, and thus the dynamism of matter was a means to temper self-love, which Shelley recognized could be selfish. The poet muses:

> Man, one harmonious Soul of many a soul
> Whose nature is its own divine controul
> Where all things flow to all, as rivers to the sea;
> Familiar acts are beautiful through love (IV.400–404)

In the previous stanza, Shelley had described the forces of love and might, and here he makes those forces the ground of the harmonious soul that is itself the ground of many a soul.[128] Force is what interconnects; love as force does not expunge "mean passions, bad delights" (IV.406), but rather those entities give love's attraction its work. By highlighting the way in which love takes familiar or habitual acts and makes them beautiful, Shelley shows how physical causality and habits take on states of mind. And in making "divine controul" part of the soul's own nature, Shelley allows for free will even as he makes the individual a metonymy for the world soul, but one separate from it, although the same force interpenetrates them. Disavowing the possibility of idealism as a form of solipsism, Shelley insists, "Let it not be supposed that this doctrine conducts to the monstrous presumption that I, the person who now write and think, am that one mind. I am but a portion of it" (Ingpen and Peck, "On Life" 6: 196). The poet's metonymic understanding of the self as part of the forces of the universe is precisely what prevents that solipsism. At the same time as he unites self and world soul but with a difference, divinity becomes human as it is now part of the soul's nature.

Shelley often uses "shape" to describe what would be matter, and deconstructionists have insisted that this term refers to figurality itself. According to Paul de Man, the shape is "the figure of the figurality of all signification" (*Rhetoric of Romanticism* 117). Elsewhere I have argued that deconstruction indulges in a mattercentrism so that language can be the undoing of matter.[129] The deconstructionist understanding of shape perfectly illustrates my point, because it turns out shape was in fact an important descriptor within Romantic physics. John Anderson's *Institutes of Physics*, for instance, explicitly names "shape" as one of the variables he has repeatedly tested. Famous electrician George Adams argued that "whatever is material must have figure or shape" (3: 5). Physicists then further studied how the shape of a magnet altered its attractive powers. Even Shelley's own teacher, Adam Walker, in a section on optics, treats how the particles of light, "by striking the retina of our eyes, excite in our minds the idea of light: and when they fall upon bodies, and are reflected to our eyes, they excite in us, the idea of the colour

and the *shape* of these bodies" (63).[130] He is trying to describe how the world becomes consciousness.

Rather than standing on the side of figuration, I argue, shape was an especially useful descriptor within a dynamic theory of matter, because force could and did change the shape of matter, and since the states of matter—solid, liquid, and gas—meant that the shape of matter was inconstant. Its imprecision made it especially useful to describe the forms matter could take. Arguing for the usefulness of Boscovich's definition of atoms as centers of force, Michael Faraday wrote, "The term shape would now be referred to the disposition and relative intensity of the forces" ("Speculations" 2: 292). Shelley himself linked shape to the phenomenality of matter: "When we look upon shapes in the fire or the clouds and imagine ourselves the resemblance of familiar objects, we do no more than seize the relation of certain points of visible objects, and fill up, blend together" (Ingpen and Peck 6: 107). Shelley's term "shape," then, refers to the essentially protean appearance of matter, the familiar thing we imagine as we perceive a relation between certain points and fill them in.[131] Kant, of course, downplayed the significance of shapes when he showed that all attempts to derive the different qualities of objects from the shape of primary particles was doomed to failure. Shelley has no need to turn to shape as a kind of figure for figurality because matter itself was flexible, appearing in gaseous, liquid, and solid states, and the active forces within matter made it possible to see that our sense of the solidity of objects was in fact the work of a deluded imagination.[132] Hence, the furies acquire their shapes from the shade of their victim's agonies, without which they "are shapeless as their mother night" (I.472). When Asia looks into the eyes of her sister, Panthea, she sees "a shade, a Shape, tis He, arrayed / in the soft light of his own smiles / which spread like radiance from the cloud-surrounded moon" (II.i.120–22). She sees reflected the shape of Prometheus, transformed by his retraction of the curse, literally "arrayed" with the radiance of his smiles. That radiance exudes a force that transforms a shade into a shape.

Thinking about matter as an interaction between forces allows the poet to let matter become something that unfolds within time. Hence at the start of act IV, Shelley describes matter that is in the process of fading away: the dark forms and shadows "bear the bier / Of the Father of many a cancelled year!" (IV.9–10). Materiality thereby is in process of materialization or evanescence into forces. Astronomer Herschel credited force for having formed various star clusters: "Having then established that the clusters of stars . . . are of a spherical figure, I think myself plainly authorized to conclude that they are thus formed by the action of central powers" (*Catalogue* 9). He proceeded then to call this power "centripetal

force" (ibid.). Hence Shelley's semi-chorus chants, "We whirl, singing loud, round the gathering sphere" (IV.169).[133] Their whirling is part of the momentum that allows the sphere to gather. Shelley insists that action creates matter. And hence the chorus bids Panthea and Asia:

> But now—oh weave the mystic measure
> Of music and dance and shapes of light,
> Let the Hours, and the Spirits of might and pleasure
> Like the clouds and sunbeams unite. (IV.77–80)

Usually understood as a given empirical fact, and one of the goals of science, "measure" is here transformed into the artful product of weaving, a transformation that allows the measure of song (in the sense of duration of a note) to encapsulate the measure of matter. By once again stressing force and effort in the infinitive form of "weave," Shelley insists upon matter as a process, a point underscored by the fact that force determines the measure of a shape. Heightening that claim is the previous stanza, which depicts the hours as they once were: "hounds/which chased the Day, like a bleeding deer," but those appearances have vanished. Shelley's simile here then works as not so much a form of figurality but rather as an indication of the dynamism of form. Describing her own birth, the moon recounts being "Borne beside thee by a power/Like the polar Paradise,/Magnet-like, of lover's eyes" (IV.464–66). Even as love, eros, polarity, and magnetism are brought together as one shaping force—so that even the symbol of chastity is not immune to love—Shelley describes how force leads to the very birth of the moon: once again force in the form of action precipitates matter as the effect of force. Matter is thus not the cause but the effect of force.

All this has manifold implications for Shelley's relation to idealism and skepticism. Though the recent critical history has stressed his skepticism, that skepticism is based upon a theory of language that misunderstands the poet's relation to matter. By reconnecting his skepticism to matter and not to language, I argue that Shelley's decentering skepticism could never be nihilistic. Rather, the inevitable changes in the forces that compose matter offer both hope and fear, but with this difference: matter remains in the form of dynamic forces, and love is one such form of force. Stuart Sperry defends Shelley as primarily a poet, not a philosopher, and he argues that the poet's "primary allegiance is by definition not to the things of this world but to what may become, and their eye is not on the earthly object but on the imaginative and ideal" (*Shelley's Major Verse* 70–71). My treatment of Romantic matter demands no such choice between things and ideals, because

force circulated between things and ideals, description and prophecy. As the very effect of force, matter can be changed.

Shelley's critics have mistakenly understood Shelley's dilemma. Take, for example, Michael O'Neill's reading of Demogorgon's lines in act IV: "Fate, Time, Occasion, Chance, and Change? To these/All things are subject but eternal Love" (lines 119–20).[134] O'Neill argues that "eternal love" is "an abstraction that the entire act has striven to incarnate in its fictions" (109), and he links abstraction to that which "does not exist beyond the individual will" (ibid.). Because it is based on the force of attraction between two things, love is no abstraction, which means that Shelley need not struggle to "incarnate . . . fiction" (ibid.). Its electrical materiality makes it highly reactive, creating a force field that compels but does not command. The same holds true for his understanding of the discharging imagination. In this way imagination and love are forces but not tyranny. That the lines are rigidly iambic pentameter both undermines our sense of abstraction and suggests that while love may not be subject to the five actors named, it is still beholden to metrical force. Love, therefore, is not about the transcendence of the laws of nature, but neither does it materialize in any concrete permanence. It materializes as an interaction, influenced by what it interacts with. In a later reading of the Spirit of the Hour's speech, O'Neill tries to credit physics and figuration too: he insists, "'Spiritual physics' work lucidly here, adequately imagining transformation by refusing to be wholly figurative" (117), at the same time that he asserts, "Figurative language sharpens rather than devitalizes the force of [Shelley's] argument" (ibid.). O'Neill waffles between the strengths and limits of figuration: in the former, physics compensates for the limits of figuration; in the latter, figuration sharpens. My point is that Shelley did not have to choose between the strengths and weaknesses of figuration because a dynamic physics of force teemed with action, making figuration ancillary.

When Shelley argues for difference without discord, he eschews the violence of difference but retains difference because it challenges what would otherwise remain egocentrism or Alastorian solipsism. To the extent that Shelley understands an ultimate unity of force in a harmony that nonetheless makes a space for difference, Demogorgon's violent overthrow of Jove is analogous to Prometheus's attempt to recall his curse, which, in turn, is analogous to Prometheus and Asia's marriage through the forces of attraction.[135] Here, the deconstructive understanding of analogy as a figure that disrupts any essential relation between the two terms being compared will not account for the fact that Shelley considers analogy to be a law of the imagination, one that both recognizes and embodies the tendency of

the forces of nature to attract and repel one another. The binary thus acquires an ontological relationality that will permit neither the privileging of one over the other nor the claim of ontology beyond relationality. For Shelley, then, analogy literally matters because it specifies a relationship whose material basis has yet to be discovered or understood but takes the name of love. It allows for the concurrent presence of idealism and skepticism, since analogy embodies the attractive forces, the electrical matter, between two things.

One key question ensues: If love is a force that holds together aspects of the universe, when is force necessary, and when is it a product of tyranny? Shelley insists that "love and might [are] to be divided not" (IV.394), and this means that he recognizes that you cannot have one without the other. For Shelley then, freedom is not the absence of compulsion, since we are surrounded by the forces of nature, which are in turn governed by laws, but rather we are free to choose the forms of compulsion we are compelled by, and, lest we forget, love is itself a force of compulsion that one must choose.[136]

Although force "compels the elements with adamantine stress," Shelley argues, "As the Sun rules, even with a tyrant's gaze, /The unquiet Republic of the maze / Of Planets, struggl[es] fierce towards Heaven's free wilderness" (IV.397–99). The sun rules even with a tyrant's gaze. However, the order of the universe is a republic, one without a king, a tyrant. Shelley ironizes the foundational alexandrine of line 399 into a wilderness of space, hardly the stuff of conventional foundations, but that foundation is held together not by solidity but rather by gravity and metrical force. Because force in physics begins as a term analogizing human will and effort, that will becomes a force that can reckon with the forces of matter, making matter into a fait accompli, the result of action.[137] Shelley sees gravity as a force that quells the planets into as much order as a maze can provide, but he insists on the eternal struggle against that force. "Even" indicates parallel forces and makes omnipotence a fantasy. Hugh Roberts's application of chaos theory to Shelley offers an especially helpful gloss on these lines: Shelley recognizes that disorder emerges out of order as much as order emerges from disorder (251), and this again makes it possible for him not to choose between idealism and skepticism.[138] The poet therefore insists on simultaneous order and disorder: mazes are an especially bewildering form of order, even as active forces impose temporary order on matter. Roberts suggests that this disorder is what inspires the ordering of imaginative creativity, once again reinforcing an attraction between matter and imagination, but such creativity is disordering as well.[139]

When Shelley refuses to separate power from love and might from peace—Panthea refers to peace as "a mighty power" (IV.510)—he underscores force as

both love and might, and peace and might. Likewise, Demogorgon announces that "Love from its awful throne of patient power . . . folds over the world its healing wings" (IV.557, 561). That healing power would not be effective without the "awful throne." The key then would be to choose love and peace rather than allow oneself to be passively determined by them: the very fact that love is a force means that its attractiveness needs to be dealt with. This recognition that love and force necessarily belong together returns us to what Shelley critics like Tilottama Rajan have seen as the displacement of Demogorgon's violent upheaval of Jupiter by Asia and Prometheus's marriage (241). My attention to force, however, allows us to see both these events as two sides of the same coin, and Shelley's conception of love supports such an analogy because it is both force and love. Where Rajan reads *Prometheus Unbound* in terms of "the disconnection of acts, agents, and ideas," which expresses a narrative "semiotics in which vehicles exist without clear tenors, so that characters and their actions become figures for the form of a content rather than the content itself" (246), I locate this disconnection within force and matter, and thus within Shelley's understanding of force as having a home in matter. Because within force there is a fundamental ambiguity about the source of the action, a dynamic theory of matter necessitates a struggle between human effort and physical laws. Thus, Shelley can have his content and reflect upon it, too, since the mobility of that content foregrounds the problem of what is acting and what is acted upon. If Rajan's Shelley is traumatized and haunted by the continual incongruity between tenor and vehicle—trauma is the psychological equivalent of endless deferral—my version of Shelley is not suffering from a lack of content, or what is essentially a linguistic disease, because love as attractive force literally counteracts the force of tyranny. The moving presence of force provides a changing content but not monolithic meaning, and in fact the relative order or disorder of matter within the universe means that change will come. The question for Shelley is how to prompt it. It is also how to obey the force of love and have sovereignty at the same time.

Shelley argues this point fairly explicitly: "If we permit our imagination to traverse the obscure regions of possibility, we may doubtless imagine, according to the complexion of our minds, that disorder may have a relative tendency to unmingled good, or order be relatively replete with exquisite and subtle evil . . . Order and disorder are expressions denoting our perceptions of what is injurious or beneficial to ourselves, or to the beings in whose welfare we are compelled to sympathize by the similarity of their conformation to our own" (Ingpen and Peck 6: 52). In a remarkably prescient Nietzschean move, Shelley worries that our designation of order as either good or evil results from our psychological perception of

our individual benefit. Here, Shelley urges that the imagination be trained to see the order of matter beyond individual benefit by looking to a collective good that is not merely self-regarding. The imagination must be willed to do what it does: Shelley's verb is "permit."

Part of what Shelley is trying to dramatize is the work of tyranny and how it might be overcome. His turn to force, then, undermines the subject/object dichotomy, even as it frames the work of love as a force that must counter tyranny.[140] After all, if matter is composed of forces, then how can one side be an actor and the other side merely passive? Tyrants like Jupiter ignore the larger forces of the universe and instead seek to dominate by designating subjects as objects: he proudly declares, "all else has been subdued to me" (III.i.4). By connecting the division of subject and object with tyranny, Shelley anticipates Heidegger's argument that the subject position is necessarily one of dominance. In the opening scene, for example, Prometheus's splayed body renders him a virtual object.

This emphasis upon dynamism and action makes the universe and the self continually revolve and change, but how then does one know good from bad changes? More critically, how does one spur changes for the better? Under tyranny, the danger is that one forgets the dynamism of the universe. Hence, Prometheus perceives "no change" in the opening scene of the lyrical drama, and hypostasis makes for pretty boring drama. And yet he is surrounded by change, as he admits without knowing it. He describes, for instance, the "crawling glaciers," and he is surrounded by whirlwinds. More to the point, in his initial blindness to the changes around him, Prometheus values his identity and endurance, and these resist change rather than foster it. What Prometheus cannot initially see is what the chorus will later remind him: "Ruin now Love's shadow be" (I.780). Although he cannot perceive it, that does not mean love does not exist in the world, especially if ruin is really love's shadow. And hence Jupiter does not understand that his thrones, altars, scepters, and tiaras "were like those monstrous and barbaric shapes,/the ghosts of a no more remembered fame" (III.iv.168–69). "Shapes" here captures the dynamism of force, and thus the permanence of such things is actually a mirage.

Shelley provides an important clue to how he thinks human beings can foster positive change when he shows earth to be animated by love. He makes it clear that circumstances, and even poetry, can awaken us to action. He understands action and emotion both as forms of motion, motion being the external symptom of force. Kant, we recall, defined matter as the moveable because movement was what allowed us to perceive it. Prometheus opposes Jupiter's omnipotent force, and thinking about the emotions in terms of force allows sensibility to shade into action. And yet Shelley insists that love too forces: "Love rules, through waves

which dare not overwhelm,/Forcing Life's wildest shores to own its sovereign sway" (IV.410–11). Framing love as a force accords it power, a power that can look suspiciously like tyranny, a suspicion fueled by Shelley's choice of verb: "rules." And yet this similarity is what allows force to fight force, for, without power and rule, love would be feckless. What Shelley's detractors have seen as naïveté or sentimentalism is in reality much more complex.[141] Shelley dramatizes the power of love by both refusing enjambment here and by making force into a gerund. If his commas reign in the waves, the wildest shores are "forced" to "own" their sovereignty. If Shelley envisions one being forced into the embrace of one's own sovereignty, the coercion of force is mitigated by the fact that one can and must choose own one's sovereignty. In so doing, Shelley defines free will in terms of willing the attractions we act upon: so long as one wills what one is being willed by—in this case, love—one thus holds onto free will while willingly being reined in by love. Because action straddles the physics of force and the emotion of the subject, the physics of force becomes the backdrop against which human will can be found and measured.

Shelley expands beyond love to consider the forces of emotion generally; his physics includes a physics of emotion, what I have elsewhere called the "motion behind emotion."[142] Here he probes the fact that motion is part of emotion, and, since dynamic thinkers thought of motion as the symptom of force, Shelley understands the emotions as forces that we allow to move us. Shelley has the Chorus of Spirits announce:

> We come from the mind
> Of human kind
> Which was late so dusk and obscene and blind;
> Now, 'tis an Ocean
> Of clear emotion,
> A Heaven of serene and mighty motion. (IV.93–98)

Of key interest here is the rhyme almost riche between "Ocean," "motion," and "emotion," a triplet that underscores links among mind/imagination, natural force, and emotion. This rhyme replaces "mind"/"kind"/"blind." Thinking about emotion as both a force that moves us and a force that we allow to move us complicates the relation between emotion and subjectivity by rendering emotion both exterior and interior to the self, both willed and forced. The fact that Prometheus does not will his pity for Jupiter but pays attention and acts upon it means that emotion need not be originally self-willed to be moral.[143] The crucial thing for Shelley is first to feel it and then know what to do with it. Emotion thereby be-

comes almost an externally imposed root of the collective, working through a kind of contagion of motion. When Shelley pits a clarity of emotion against blindness, he demands that his readers reflect upon how the individual can better be in harmony with the shaping forces of the world. Stuart Sperry has argued that Shelley knew "that if change were ever to come, it would come as emotional realization" (*Shelley's Major Verse* 68), and I would add that his sense of emotion as a force enabled him to understand emotion in relation to the physics of the universe. The fact that we are impelled by emotion does not make it morally bankrupt, because we can choose to feel it or not, to be moved by it or not, and we can own it as if we originated it, even if the feeling is originally not quite our own. To wit, Shelley makes evil characters like Mercury parasitic on the emotions of their victims without ever really owning those emotions (84), thereby offering a negative example of what he hopes to encourage.

Hence, after Prometheus has triumphed over Jupiter, his mother, Earth, celebrates:

> The joy, the triumph, the delight, the madness,
> The boundless, overflowing bursting gladness,
> The vaporous exultation, not to be confined!
> Ha! Ha! The animation of delight
> Which wraps me, like an atmosphere of light,
> And bears me as a cloud is borne by its own wind! (IV.319–24)

The emotion or force of joy will not be contained even within the vastness of earth. Shelley's caesura between the metrical foot less/o highlights this overflow—underscored in his open "o"—as does his insistent gerund forms of the verbs, not to mention extra syllables in lines 320 and 321. Moreover, earth refers to the "animation of delight" as being external to herself—she is after all wrapped in it, transforming her from acting subject to enunciated object, borne by its own wind. The animation of delight, as it were, breaks down the borders of subject and object because its origins are without, and yet it animates her. As she becomes a cloud borne by its own wind, she is transformed into a force that is nonetheless forced by a force that she will come to own. Not only does Shelley thereby show how the subject/object binary consolidates power in the form of violence; he also diffuses power/force so that it resists the kinds of containment we can imagine because it is a forced force, which initially wraps the earth only later to become part of it. Simultaneously, he argues that claiming ownership of the forces that move us—ownership of emotion in this case—amounts to a potential exercise of authentic free will. Earth is, after all, inspired and borne like a cloud by her own

in-spired wind. The borders of the subject have been obliterated, with the goal of rendering the subject a form of energy that performs work in the world.

Even though earth describes her experiences as a kind of rapturous disorder, the poetic lines and their insistent commas absolutely order all of this joy. Shelley suggests thereby that disorder is perceptual. Since forces of emotion regularly exceed the subjects who would try to contain them, this turn to perception begins to reconsolidate the subject. Such excess defies the permanent containment of forces, demanding a continual readjustment of activity that reshapes the subject. What can hide man from Mutability, indeed?! At the same time, such disorder is in fact metrically ordered, reminding us that force and love can be beautiful.

This raises the question of how does one know the difference between good and bad changes? The answer: by how one feels, as measured against how one should feel. Prometheus tells the second fury, "I weigh not what ye do, but what ye suffer/Being evil" (I.i.480–81). Action has an emotional impact, and suffering is the sign of evil. When Prometheus kisses the Earth, otherwise known as his mother, she responds:

> I hear—I feel—
> Thy lips are on me, and their touch runs down
> Even to the adamantine central gloom
> Among these marble nerves—tis life, tis joy,
> And through my withered, old and icy frame
> The warmth of an immortal youth shoots down. (III.iii.84–89)

Without the force of love, earth takes on the form of barren matter, all hardness and adamantine. The kiss injects some much-needed warmth, awakening otherwise dead matter that appeared to have lost its vitality into joy and life. Matter moves beyond mechanism, and Shelley's enjambment highlights the positive force of love as marble earth is liquefied into life.[144] Insofar as the warmth of youth "shoots down," she now feels a vitality beyond mechanism: "shoots" hints at the organicism that she was always supposed to feel, and, by implication, mechanism is not true feeling.

Thus, the Spirit of the Earth, previously identified with atmospheric electricity, notices how the recall of Prometheus's curse leads to "All things put[ting] their evil nature off" (III.iv.77). Forgiveness transforms an evil nature into something that can be put off, or an appearance. "Adamantine" suggests the life of Adam was always present. The spirit then comments, "So with my thoughts full of these happy changes/We meet again, the happiest change of all" (III.iv:84–85). In describing changes for the larger good in terms of "thoughts full of happy changes,"

Shelley insinuates that good will allow the form of happiness to appear in thoughts. Contrast this happiness to Mercury, who, because he is acting on behalf of evil and knows it, feels nothing but remorse when he summons Prometheus's torturers. Initially the Spirit of the Hour records the cosmological change resulting from Prometheus recalling his curse: "There was a change . . . the impalpable thin air/And the all-circling sunlight were transformed/As if the sense of love dissolved in them/Had folded itself round the sphered world" (III.iv.100–104). It perceives a change, but it has no instantaneous meaning, and it is only the Hour's "as if" that allows him to see these changes in terms of intentionality. As he wanders "among the haunts of mankind," he remarks:

> And first was disappointed not to see
> Such mighty change as I had felt within
> Expressed in outward things; but soon I looked,
> And behold! Thrones were kingless, and men walked
> One with the other as spirits do,
> None fawned, none trampled; hate, disdain or fear,
> Self-love or self-contempt on human brows
> No more inscribed. (III.iv.128–35)

The Spirit of the Hour expects an immediate transfer of inner feeling to outward manifestation, and such a transfer is only possible if there is an intermediary between the two: namely, forces. The feeling of the change in emotional terms triggers the search for an outward expression of those inner forces. As the emotions of hate, disdain, and fear evaporate, they are indeed replaced by love. Shelley's insistent repetitions of "none" recall Prometheus's initial perception of absence when he is chained upon the rocks and indicate a symmetrical rebalancing of forces that unfolds with the drama, shunting aside tyranny. Because he understands matter in terms of dynamic forces, Shelley remains optimistic that changes, although inevitable, hold the possibility of the good, and one can know so when emotion synchronizes with the dynamic forces of the universe, thereby increasing signs of vitality.

In sum, then, thinking about matter as dynamic allowed Romantic writers to enlist matter in the process of change and, in that process, demand reconceptualization of both the human subject and agency. As the essence of matter shifts from solidity and permanence to the forces of attraction and repulsion, matter is reimagined in at least two ways. The version of matter that is corpuscularity becomes evidence of a deluded imagination, one that relies on a material link from body to body, and in so doing dramatically limits possibility to action without dis-

tance. That is, in this physics, only things that are touching can influence one another. Both electricity and magnetism posed great difficulties for such a theory. By contrast, the disciplined imagination understands the forces underlying the surface of matter to be both the ground of our ability to encounter it and an ecological stance in which everything is involved with everything else, and thus agency has reciprocity and consequence in the universe. And yet, because this ground is always shifting, matter neither allows for the simple reification that is ideology nor the refusal of thought, since this change must continually be reapprehended. In varying ways, then, Boscovich, Kant, Davy, Priestley, Marcet, Faraday, and Shelley turn to dynamic matter to reconceptualize the subject as continually dissolving and being remade, which, in turn, remakes the objects that bring the subject into being. Shelley, in particular, further rethinks human agency, whether this takes the form of the collapse of dualism, or the recognition of how to interact with the forces of the universe, or the willing acceptance of being moved, or the making of the self merely one center of dynamic interactions. The Romantic imagination's central role in the very reimagination of matter further demands our rethinking of what its materiality means and does, and undermines the claims of figurative language to undo ideology, because matter already is believed to have the necessary resources to do away with logocentrism and the politics that ensue from it.

CHAPTER 2

William Blake and the Neurological Imagination

Romantic Science, Nerves, and the Emergent Self

William Blake understands the imagination to be embodied in the nerves. Nelson Hilton has shown how fibers treated by Blake are "the conducting passageways of the vital spirits of imagination (spirits that, as Los says, live in the brain and nerves)" (98). Central to *The Four Zoas* is the construction of nervous bodies. Hence, in this chapter, I ask, Why did Blake simultaneously reduce the imagination to the nerves—thereby seemingly risking a physicalism devoid of spirit and an automaticity that denies intentionality and consciousness—and associate his poet figure, Los, with loss? (Physicalism is typically thought to do an end run around mentality, autonomy, and context, not to mention the theological soul.[1]) In so doing, I argue, Blake paradoxically gains a kind of universalism that escapes the limits usually associated with physical reductionism, and he is able to do so because Romantic physicality included entities like imponderable matter, entities that do not disallow spirit. I turn to Blake's *The Four Zoas* to consider the ways in which neurology of the period facilitated a flexible materialism that included both spirit and a dynamic materiality in the form of life, but one nonetheless with a reductionism driving toward a unity that can only be gestured at through narrative. As Blake puts it, "A Perfect Unity/Cannot Exist" (N1 E300: 6–7).[2] Romantic neurologists likewise recognized that reductionism was a heuristic, linking forms of it with probability, and thus could contemplate both what it enabled and what it cost.[3] Criticism has shown how important unity was to Romantic science,[4] but it has neither broached the implications of this unity for the scientific goal of reductionism nor elaborated upon how scientific reductionism in the Romantic period could be perfectly in keeping with art's formal unity, a unity that Blake insists brings with it loss. Because humanists are so eager to cast the stone of re-

ductionism upon scientists, they are sometimes blinded by the fact that textuality is a brittle, not to mention aging, glass house. From a scientific perspective, reductionism is simply the work necessary for science to have a purchase on a problem. When Blake equates poetry with loss, he reminds readers that both art and science engage in a kind of reductionism so that the reader's imagination remains engaged. Given the vertiginous textual plenitude of the poem—where the characters morph into each other—the reader craves loss: some kind of path through. Textual weaving thereby dovetails with nervous branching.

Because Romantic writers recognized that unity was especially a problem when it was about the imposition of hierarchy, art and science then together strove for what Coleridge called multeity in unity, a unity that did not absorb all difference. This unity with difference is one key reason why Blake ends *The Four Zoas* by imagining "sweet Science [to] reign" (N9 E407: 10), and it can do so because "the dark Religions are departed" (ibid.).[5] For Blake, dark religions like deism and natural religion suppress imagination and prevent enlightenment. When Blake equates "the golden armour of science" with "intellectual war" (ibid.), science is given the potential to offer improvement because, while war retains the energy of difference, science provides some armor. This "remainder of difference" in intellectual war speaks to the limits of an eliminative reductionism that would get rid of all other levels making any such war impossible, even as it demands that we consider the materialization of poetry as necessary loss.[6] If the poetry were fully embodied, Blake would do away with the need for imaginative interpretation. Hence Blake turns to allegory—"other" speech—because it demands comparisons without eliminating differences. Its unbound status—Blake never had *The Four Zoas* bound—is only its most manifest form of its plenitude.[7]

Although we today understand vitalism to resist reductionism, vitalism was an important strand of the science of the time. Geneticist François Jacob goes so far as to claim that, without vitalism, biology could not establish itself during the period (92), and his reminder that biology moves simultaneously in two different directions—integration and reductionism—helps us capture why vitalism could have such purchase. Vitalism encouraged work in both directions. As a principle, it gave at very least a regulatory idea for biology to focus on. And because this idea could not be firmly localized in any single instance, to pursue it, one had to expand one's horizons to the very plenitude of nature. For those like Humboldt who believed that the organic was simply a higher form of the inorganic, those horizons expanded to things.

Because vitalism in Romanticism was a part of scientific explanation especially when it resisted vitalist substances and instead relied upon processes, it enabled

a flexible reductionism that, in turn, licensed art and science to work together to imagine forms of fluid embodiment that lent intelligibility especially when mechanism was deemed an insufficient form of explanation.[8] In brief, because nervous "organization" in the Romantic period stood for the process by which an organized structure is formed (Figlio 40), it was inseparable from life yet was used to gesture toward the idea of living structure while leaving highly ambiguous the exact relation of nervous material to function. Simultaneously, emphasis was tilted toward animation and away from the structures and mechanisms that enable it so that the ideal of autonomy can be preserved (41).[9] The Romantic use of "organization" was not just a form of obfuscation but a scientifically necessary way of both gesturing toward a structure in process and self-organizing systems (like Buffon's *moules intérieur*), which fend off simple determinism.[10] Moreover, because self-organizing systems are capable of moving the boundary between agent and environment, they thus have an unpredictable radical plasticity. An added boon for humanists: multiple levels of interacting organization allow for mind and intentionality.[11] Today, neuroscientists working on emotion speak about "degeneracy," the fact that many different combinations of neurons can create, just to use one instance, the emotion of fear (Barrett 19). Finally, this turn to organization was also a turn to ecology: living things became integrated into nature and into their environments (Jacob 86). Literally so: Humboldt's speculations on "social plants" led to the formation of the science of ecology (8).

Hence, in *The Four Zoas*, Orc begins "to Organize a Serpent body/Despising Urizens light & turning it into flaming fire" when he needs to work against Los's "cold hypocrisy" (N7 E356: 44–45). Three points need to be made here. One, Orc's vitality organizes the body, granting it a purposiveness that resists any externally imposed instrumentality. Two, this resistance enables it to foment revolution, symbolized by Orc's flaming fire and its ability to douse Urizen's light.[12] Teetering between substance and a verb, "organization" was and is a way of refusing to assume, as Paul Ricoeur puts it, that a dualism of referents (body, mind) implies a dualism of substances (14). Finally, organization was then a form of localization that could enhance synthesis: in *Neural Imagination*, Irving Massey notes that "neurology is more effective in analysis than synthesis" (18), and he worries about the loss of the whole experience within neuroscientific accounts of aesthetics. However, embodiment within a decentering nervous network could address synthesis because the idea of network makes fungible the basic unit of analysis, moving as it does from a nerve to a network of nerves. Networks demand sliding scales, and the nerves are simultaneously part and whole. For Blake, embodiment demanded that nervous being be inextricable from making, or the continuous work of imag-

ination. Central to this making is the feeling of pleasure and aliveness, which is what the nerves are about. In this, the Romantics anticipate how Agamben questions the current passive acceptance of the reduction of the life sciences to "biopower" when "life itself is the power that exceeds its forms and its fulfillment" (490). Blake illustrates life's excess when he shows how, despite all of Urizen's and Vala's energies devoted to melting bodily forms in the furnaces, bodies remain divine forms.[13] In Night 4, Blake will suggest that "disorganizd" equates to being "rent from Eternity."

Even today, "organization" places distinct limits on what reductionism can accomplish because it widens the scope of localization from single areas to distributed networks to make space for autonomy, often by pushing it to a higher level.[14] Biologist Steven Rose reminds us that "neither neurons nor synapses are isolated monads," and that the way the units are organized is crucial to understanding the brain (148).[15] Professors of psychology and philosophy, Maurice Schouten and Huib Looren de Jong submit that "the organization of the parts and interactions of the mechanism with its environment requires (semi)-autonomous higher-level research" (16). Philosopher Robert Richardson adds, it is not "structure that illuminates the reduction, but the dynamics, and dynamics are driven by explanatory rather than metaphysical needs" (138). Researchers at Dartmouth, moreover, have very recently argued that the imagination requires a widespread neural network to consciously manipulate images in the brain.[16] In the Romantic turn to nervous organization to understand sensibility, we see the primacy of the dynamic over the structural, allowing for a robust vital embodiment that allows for the emergence of consciousness without denying the possibility that a future science will heal the gap between the brain and mentality,[17] which helps us to understand Blake's interest in neurology and nervous anatomy. Emergence, moreover, means that the whole exceeds the sum of its parts, and that results cannot be predicted. That Blake's nerves are metonymic allows them to resist externally imposed syntheses by branching in unexpected ways. Isabelle Stengers helps us grapple with the issues here: she argues that the centuries-long confrontation between mind and body fails to introduce "any precise requirements or obligations" (*Cosmopolitics I* 89) because what is captured is a result or invention of research. Her example is the neuron, which has "no determinate reference to the brain as such" (93), and which must be imagined as an agent, which Blake does by giving it a kind of Kantian purposiveness, but in the form of pleasure.[18]

Neurology of the Romantic period gave wide berth to the imagination even as it embodied it in a complex network of nerves. In the gap between structure and function, there were many ways for the nerves to work. Fluids, spirits, vibrations,

and electricity name the main schools of thought. Blumenbach detailed the various "opinions" of physiologists—animal spirits, electricity, magnetic effluvia (*Elements* 159)—only to prefer a model that relied upon the movement of nervous fluid, specifying "oscillatory vibrations, when subjected to the action and influence of stimuli" (ibid.).[19] Since sensibility as purposiveness enabled nervous function to require little or no anatomical support during the Romantic period (Clarke and Jacyna 159), the ideal of life as a form of purposiveness stood in for a sufficient explanation.[20] Robert Young notes that Franz Gall did not even feel embarrassed at the fact that he had almost nothing to say about nervous physiology (*Mind, Brain* 30); all he did was to specify the organ as the material condition of its function and make behavior the form of function. A second practical solution to this problem was to accept nervous animation as a theoretical object to be provisionally accepted as physically real (Nagel 147) so that the nerves could make sensibility intelligible. Another way of saying this is that animation could remain imagined so long as one qualified its status as knowledge as imagined or speculative or for the limited purposes of intelligibility. The turn to nervous energy or excitability, moreover, compensated for the difficulty of correlating nervous diseases to lesions, which of course could be found only during an autopsy.

Yet Romantic neurologists could be remarkably modest. John Hill wrote in *The Construction of the Nerves and the Origin of Nervous Disorders* (1758) about what he had "persuaded" himself he had seen in the nerves (2). Alexander Monro II admitted, "Every one of these opinions [on the formation of the nerves], on very important points, will, perhaps, be found doubtful or erroneous when we consider them fully" (24). Scottish physician Robert Whytt used the "name of animal or vital spirits" but made it clear that he was not committing to "any view of ascertaining its particular nature or manner of acting" (*Essay* 9), deeming it sufficient to stipulate the existence of a power "in general, though its peculiar nature and properties be unknown" (9). Much like the Romantic physiological object, which is open to revision when proof warrants because it is more epistemological than ontological, the nerves invite imaginative ontologies that have provisional status.[21] Of course, scientific objects demand an elasticity that allows for technological changes, or else they risk becoming moribund, and this is why they take on a kind of figural elasticity. Even today, neuroscientists need only to claim a commitment to a future mechanism rather than specify an actual mechanism, and Catherine Malabou's work on the different kinds of neural plasticity shows how neuroscience constantly defers that specificity by moving between these definitions.

Blake not only embodies the imagination in the nerves, but he also dwells in

The Four Zoas upon the literary and scientific implications of reductionism.[22] In fact, mankind's fall from divine grace is experienced as a kind of brutal reductionism to dead matter, but corporeality does not in Blake mean the automatic death of spirit. His idea of the body divine refuses the presumption of an a priori rupture between body and spirit.[23] To wit, Blake often represents mental strength as muscularity (Damrosch 125). Early on, Blake announces the subject of *The Four Zoas* will be Albion's "fall into Division & Resurrection to Unity" (N1 E301: 4). I will show how he understands the human body divine as expansive, and not as a necessary constraint—despite the valiant and insistent efforts of Vala and Urizen to reduce it to deadly fixity—or structures without functions (a mundane shell) or structures with dead functions (Blake's zombies). And since the characters seek to avoid eternal death and find regeneration, Blake suggests how reduction to nervous embodiment can avoid the former while attaining the latter. Blake emplots reduction along the Christian idea of the fall, which, for Blake, helped human beings to forget their divinity, but the nerves as organs of pleasure resist such death along with the moralizing of pleasure.

Reductionism has literary implications as well, insofar as it enabled comparison between perspectives that appear to be incommensurate. Nonetheless, by multiplying the agents who manipulate the bodily structures in his works as if they were inert and not living, Blake warns, on the one hand, against forms of reductionism that forget the spiritual dimensions of life otherwise known as animation/vitalism and, on the other hand, against ways of understanding that would turn to universals without context. In this view, bodily organization is context dependent. There are four zoas and multiple eternals, and each represents the contingency of experience despite Urizen's attempts to reduce the body into constraint to consolidate his power. That each zoa embodies one of the four energies in every human being (Urthona/Los as imagination; Urizen as reason or law; Tharmas as instinct/desire; and Luvah/Orc as passion) multiplies the differences and likely combinations. Hence, each character in Blake brings to the situation at hand an emotional and environmental context that helps explain his or her actions, which, in turn, are presented as potentially both redemptive and damning, a move that again insists upon context. Enion thus murders Tharmas's emanations, for instance, only to discover that they were hers as well (E 304). Humankind's fall can become a fortunate fall, but only so long as the imagination is not reduced to dead fibers, and insofar as the fall itself is understood not so much as a historical event that has occurred in the past but rather as one in the present reader's imaginative engagement to resist it (Ault, *Narrative Unbound* 10). By equating the materialization of poetry with Los/loss, Blake reminds us both that even his illuminations

cannot substitute for the reader's imagination and that death is necessary for creative embodiment to occur.[24]

Although moral philosophers like Frances Hutcheson, Edmund Burke, and David Hartley sought to connect nervous anatomy with moral sense, associating pleasures with virtues and pain with vices, Blake vigorously contests the reduction of nervous anatomy with conventional moral values, since he shows damning acts to be unwittingly redemptive, and since he considers the nerves as a dynamic open network that learns. Urizen admits, "I have erred and my Error remains with me" (*FZ* N9 E391: 225), suggesting that error becomes a part of his being and thus not something forgotten. Acts in Blake exceed their intended consequences, and consequences depend upon the scale at which one views events. Moreover, by constantly playing "higher" levels of organization against "lower" ones, as Blake does with emanations, specters, vegetated bodies, shadows, and gender, and by having "higher" and "lower" continually switch places, Blake confounds a reductionism that would allow one level to speak for all even as he insists upon a nervous imagination that is multiply realized and requires narratives to stitch together the levels. "Lower" levels often act with surprising emotional passion if not complexity. And, indeed, the proliferating cast of characters in *The Four Zoas* amply testifies to the ability of individualized nervous embodiment to yield similar states like jealousy and possessiveness, which hints at a unity that does not let go of difference.

Of course, multiple realizability is the standard philosophic refutation of reductionism. The logic goes like this: How can we explain why a single property, state, or event, can be realized by many distinct physical kinds?[25] Romantic reductionism allowed for multiple realizations since nervous structure before cell theory was only a loose idea, and since comparative anatomy—and the incredible anatomical collections of the Hunter brothers—built knowledge of higher forms on lower ones. Furthermore, even now, philosopher Robert Richardson argues that science is not so much theory reduction as a "succession of models constituting partial solutions based on inadequacies to specific and local problems" (138–39). Richardson allows us to narrow the gap between Romantic science and current science, because nerve specialists model physiology and correct those models in light of subsequent developments.[26] In thinking about how reductionism gets operationalized within science, Richardson sees the imagination and adaptation of models, which engage with the particulars of scientific knowledge and work through their implications. If we apply his wisdom to Blake, we can wager that Blake looks to both model the nerves and, in so doing, to model solutions based on inadequacies within individual approaches to the fall.

Imaginative modeling allows us to see how neurology not only exploits the imagination's powers of visualization but also brackets those models as being subject to kinds of scientific confirmation.[27] Neuroscientists Gerald Edelman and Giulio Tononi argue that modeling also demands a shift away from localization to process: integration in their model was not achieved in any place, but it was achieved by the process (118).[28] If the science wars and the Romantics before them framed scientific experiment as necessary reductionism, meaning by this a kind of impoverishment, some Romantic scientists dismissed the imagination's visualizing powers in advance without considering how it could offer a kind of provisional modeling of organization between levels. Just as experiment should not be judged in advance of what it can show (Stengers, *Invention* 233), imagination should not be dismissed out of hand before it can suggest connections to be scientifically ratified.[29]

In a wider view, thinking about the Romantic imagination in the context of the science of the nerves accomplishes several things. It shows the falseness of the material/immaterial binary insofar as Romantic nervous science, on the one hand, made ample space for the soul (see Haekel, *Soul*) and, on the other hand, bracketed ontological claims as speculative. The notion of animal spirits is built upon the idea of an anima. It reminds us that the imagination was far more than just an idea (Engell) because it was thought to be embodied in a network of nerves and consequently was believed to have not only force in the world but also to engage with and be shaped by that world. Indeed, Helen McNeil has argued that the zoas act "according to the requirements of the present situation, not according to a concept of stable personality" (373), and the nerves both help explain how this can be done and instill within corporeality an essential responsiveness to the environment. It undermines the equivalence of imagination to ideology because the purposiveness and organization of the nerves will not narrow to specific forms of instrumentality or purpose, not even biopower. The fact that characters perform multiple functions—Enitharmon is an emanation of Los and the form of the fallen world (Otto, *Blake's Critique* 5)—also buttresses Blake's claim that the nervous imagination is not necessarily a rigid reduction. Furthermore, despite enormous leaps in our knowledge of nervous structure, science then struggled with similar problems as it does now (i.e., the limits of reductionism and the ability of physics to speak for living matter). It even anticipated some of our current preoccupations with ecological understandings of the nerves, understandings that seek to grasp the role of environment in shaping the nervous system because they stipulate a formative interaction between organism and environment, as does Blake when he frames nervous development against a backdrop of an ongoing labor of harvest.

Indeed, the bread and the wine ritualize a future but dynamic synthesis through poetic symbols.

Unlike some current forms of reductionism,[30] Romantic reductionism entails a kind of particularity that has the benefit of being capable of subjection to empirical investigation without reduction to that particularity because everything is theorized as part of a unified absolute[31] that resists delivery. The empirical offered intelligibility something to hold onto. Because this particularity is simultaneously material and metonymic, the material takes on the flexibility of figure, thus preserving autonomy, even as the bridge from particular to absolute must continually be reimagined to maximize both intelligibility and the very comprehensiveness of the absolute. To that end, Blake even grants chaos perceptive organs "according to the Human Nerves of Sensation" (cited in Connolly 204–05). At the same time, organic unity helps to make complexity a form of simplicity, once again without absolute reductionism, because the relay between simplicity and complexity has primacy over any one version of simplicity, even as the level of simplicity that does not lose sight of a physical spirit earns the designation of a higher level.[32]

Given the danger that the reduction of the imagination to the nervous system would encourage a materialism that could deny both the spiritual and creative work of the imagination, why does Blake risk it? Although, today, reductionism is a clear enemy of the imagination, it was not then, and, indeed, one might argue that Blake insists upon reductionism even within his art so as to demand readerly engagement.[33] Readers must improvise connections between dots or levels. When reductionism is absolute, it tends to repress imagination, since everything must be reduced to a more basic level that is granted the only legitimacy. Romantic reductionism, by contrast, was far more modest. Since the very basis of organicism, the quality of being designed without presupposing the designer, articulated the existence of a plan without having to specify one (R. Richards, *Conception* 76), reductionism to the organic made the further reduction to mechanism unhelpful since mechanisms could not explain reproduction.[34] Historian of medicine Owsei Temkin, argues that since nerve specialists were not able to fathom how the nervous system integrates its various components—a problem still very much unsolved—living organization cannot be a form of mechanism as Descartes thought (*Double Face* 329). Here, neurologists harness the very failure of imagination to prove the inadequacy of mechanism as a form of explanation, while at the same time screening the failure of vitalism to specify its own workings as other than a beyond to mechanism.[35]

The fact that one cannot fathom a mechanism of course neither refutes mech-

anism nor vindicates vitalism. It does not help matters that the blanket invocation of mechanism without knowing the means of the mechanism also still functions to rescue scientists from the horrors of metaphysics, not to mention ignorance, while simultaneously screening the failure to specify an actual mechanics of mechanism under the name of mechanism.[36] Moreover, by locating meaning in the network's operation, yet in rendering that network "incapable of justifying the meaning that 'emerges' from that operation, the topology of a 'body' is created, along with the idea of autonomy" (Stengers, *Cosmopolitics II* 258). In Night 7, Los says to Enitharmon, "For thou art but a form & organ of life & of thyself/Art nothing being Created Continually by Mercy & Love divine" (E368: 359). The bottom line, however, is that nerves proffered a reduction to the physical that poets could not only live with but embrace, because it neither disallowed spirit nor upended creativity. To the contrary, the "organ of life" is a form "created continually." In Blake's case, reduction enables him to think about why pleasure is so crucial to the nervous human body divine: not merely the gratification of any particular sense or nerve, pleasure is about the overall feeling of well-being, a joy that makes imaginative life possible and vice versa.

Reductionism was further worth risking for the following reasons. Nerves provided a universalizing counterweight to Blake's otherwise impenetrable private mythology. As the very localization of sensibility in the body, the nervous system promises the twin Blakean goals of the breakdown of mind and body dualism, not to mention the collapse of body and soul.[37] If, as Ernest Nagel argues, the point of reductionism is generality and unification, Blake gains through the nerves a way of conceptualizing the development (*Bildung*) of the individual subject. And since the nerves were understood as the very organs of pleasure, Blake further gains reasons to think about how the explosive energy of pleasure resists ideological containment. At the same time, the common nervous system dictates that individual development must have universal or generalizable implications, and the problem becomes sorting out the generalizable from the truly individual. Because Blake denounces pleasure that remains merely selfish—as when Luvah achieves dominion over Albion by having Vala jack him off—the nerves remind all of the larger community that one person's pleasure simply cannot compensate for. The mere presence of two people of course does not imply intersubjectivity, since sex here is literally a form of masturbation.

For Blake, corporeality is not reduction because his bodies are coextensive with spirit, littered as they are with expansive nervous fibers that pulse with joy. Hence, Blake associates Orc repeatedly with living pulse and animation over structure: "Pulse after pulse beat on his fetters pulse after pulse his spirit/Darted"

(N7 E353: 21–22). Here, pulse proliferates through consonance, combating fetters instead of being a fetter. Moreover, Blake describes his "vital substance in these fires that issue new & new" (N7 E354: 21), making corporeality a living process whose insistent incendiary newness resists conservatism.[38] A bit later he insists, "life cannot be quenched" (N8 E381: 24), underscoring the openness of life. Reductionism to the physical does not have to be the enemy, since Blake understands corporeality to be both divine and dynamic. However, Blake does associate absolute reductionism with a kind of tyranny: the need to reduce the otherwise divine body to one thing is always for him an abuse of power. And, as the body takes on a fixity of form, one is contained by it, rather than forming it (Otto, *Blake's Critique* 80).

Blake further turns to the nerves to manipulate scale so that individual expansion becomes corporate expansion. Blake writes, "They in us & we in them alternate Livd/Drinking the joys of Universal Manhood" (N7 E359: 10–11). Notice how the first three syllables mirror the next set of three—Blake flirts with a virtual palindrome here—thereby enacting the interchange of they in us and we in them. On both sides the "in" functions as a pivot. Highlighting a common human nervous system allows Blake to turn to joy to materialize what otherwise would be an abstract intersubjectivity.[39] More to the point, the collective network thereby becomes the gauge against which even individual actions must be measured, even as individual perceptions require social ratification in order to be acted upon.[40] Malabou insists that networks deny the very possibility of a privileged vantage point (42). Blake thus gains the ability to think through the tortuous history of individuality. The etymology of this term signifies that which cannot be divided from, but the Romantic period sought to divide it. Blake explores the uses and abuses of division by splitting his characters into emanations and yet relies upon a common nervous system whose systematic plasticity nonetheless staunches the negative outcomes of division. For instance, Tharmas responds to Enion with a suicidal death drive and literal submersion in water, and he cannot redeem himself until he reunites with community. Connectivity limits the value of individual pleasure, because pleasure should have collective implications and social force. It ideally further encourages the forgiveness of sins and universal brotherhood.

Romantic efforts to ascertain the general laws of life and organization through comparative anatomy, moreover, help demonstrate that "the most elaborate forms of organization were developments of simple types: the 'highest' and 'lowest' organisms were therefore constructed upon a uniform plan" (Clarke and Jacyna 20–21). If simplicity somehow evolves into or emerges from complexity, the one need not preclude the other, and thus neurology provides an optimistic future

even when the signs of that future are nowhere visible, since simplicity does not preclude forms of complexity that cannot be predicted. Colin Jager reminds us that "emergent properties cannot be reduced to properties of their physical substrate" (paragraph 25), and this endows physicalism with unpredictability. Insofar as Blake tracks sensation from worms to mammals to humans, he is not unlike a comparative anatomist with regard to the nerves, thinking about how complexity builds upon simplicity. And insofar as comparative anatomy encouraged the generalizing of function across species, it encouraged ways of thinking about how different nervous structures yield the same states. His nervous systems traffic in pleasure, measured in the form of electrical energy, and their organization emerges from and is altered by the quantity and quality of pleasure that is experienced. Blake thus views bodies from multiple vantages, resisting reductionism to one level, and, in one instance, the "Council of God" watches man's body "clothd in Luvahs robes of blood" while the daughters of Beulah are comforted by the divine vision (N4 E337: 10–14). As if the perspectives of the council, the daughters, Luvah's clothing, and the divine vision were not enough, is the divine located in the Council of God or man's body or both? This proliferation of different perspectives suggests that Blake is interested in what we call qualia, the subjective sense of qualities, and qualia remains a problem for absolute reductionism. Neuroscientist Jean-Pierre Changeux argues that qualia demand no incompatibility between mind and brain in part because individual brains give rise to experiences we can share (18–19). The shareability of individual qualia is, however, nonetheless an issue.[41]

Blake could also understand the nerves not to diminish the soul because he understood behavior to emerge from an interaction among nervous structure, subject, and the environment. The poet's focus on nerves highlights the issue of whether the nerves passively record sensation or the degree to which they creatively generate it, and Blake hews to the side of creative generation. This is because for him sensation is always being interpreted, and thus one can work up a stance toward one's experiences that not only becomes part of the experience but shifts the meaning of individual experiences. Moreover, the emotions shape the sensations one attends to. As much as Urizen and Los contain the nerves, they branch out in unexpected ways. Within the discourse of nerves itself, the privileging of function over structure does not grant structure powers of predetermination. The role that nerves play in terms of cause or effect is further complicated by the fact that nervous structures emerge out of learning. A certain unpredictability emerges from the fact that behavior helps shape structures, which lead to new forms of interactions. Nervous embodiment is a creative, open form of embodiment, and thus to think of the imagination as being embodied in nerves in

no way results in predictability, much less determinism.[42] Blake at one point describes "Fibres . . . from the Chain of Jealousy inwove themselves" (N5 E342: 23), thereby ascribing to them a purposiveness that has been perverted into jealousy.

Blake understood behavior to be tied to fundamental entities like nerves and yet took behavior to be novel or irreducible with respect to them. Once again reductionism had distinct limits. Historically, British emergentism grows out of the need to reconcile mechanism and vitalism, with the "emergent" specifying vital processes or forms of organization but not insisting upon vital substances, since those could signify allegiance to the occult. Blake's nerves therefore generate narrative possibility and branching connections instead of closure. In *Jerusalem*, for instance, Jesus will extoll the "Fibres of love from man to man thro Albion's pleasant land" (E146, plate 4: 7), thus not only insisting upon material connectivity but also seeing no disjunction between the material and the spiritual. "Emergent" names types of interaction that are nominally consequences of levels of physical interactions but nonetheless cannot be predicted in advance and therefore are not subject to control.[43] Once again, levels and organization allow for autonomy. By seeing function as simultaneous to structure and by making both structure and function lead to unpredicted consequences, Blake sees the nervous imagination not in terms of determinism but rather in terms of possibility. David Clark explains how Blake eschews Urizenic self-mastery for the thrownness of a contingently ecstatic life (169), and his remarks help open up Blake's fascination with the nerves. No more resonant phrase than "embryon passions" (N1 E305: 25) better captures Blake's sense that nervous embodiment is an evolving process: sensibility develops like the embryo develops and "embryon" indicates the becoming of the material. It has all the materiality of a felt emotion, at once physiological and evanescent. Similarly, Orc forms a girdle that "by night was burst in twain" (N5 E341: 17), again highlighting forms of embodiment that exceed themselves. Finally, when "all Tyranny was cut off from the face of Earth" (N9 E388: 14), the "stony forms" of Urizen are replaced by "flames rolling intense thro the wide Universe" (N9 E388: 16). Of course, Urizen forgets that his bodies have multiple forms.

In keeping with emergence,[44] Blake often describes the nerves as "branching." In fact, especially when Urizen tries to shape the body into inflexible forms, the nerves extend themselves. At one point when the eternal mind is being "bounded," Blake writes, "in harrowing fear rolling his nervous brain shot branches / On high into two little orbs hiding in two little caves" (N4 E336: 20–21). Fear prompts the nervous branches to expand to the eyes, which hide. Moments later, these are described as "Panting Conglobing trembling Shooting out ten thousand branches /

Around his solid bones" (N4 E336: 18–19). Vitality and animation, underscored by Blake's accretion of four enjambed gerunds, thus insist upon the nerves' resistance to the kinds of instrumentality imposed upon them; the body has a purposiveness of its own that will not be instrumentalized into social ideology. Hence, Blake shows the nerves literally working around the skeletal obstructions with ten thousand branches. In fact, as the above example documents, the more the nerves are repressed, the more they branch. If we take on board Steven Pinker's definition of intelligence as the ability to deal with obstacles (62), we might even say that Blake's nerves learn.

Reductionism is crucial to science because nature must be unified and subjected to empirical investigation (Schouten and de Jong 3). Reductionism was also surprisingly crucial to Romantic art because of the need to see the universe in terms of unity. While the Romantics shared the goal of the unity of nature, they were wary both of an excessive materialism that denied the possibility of spirit and a unity that could be, on the one hand unfortunately isolationist and, on the other hand, imperialist. Hence, their forms of reductionism posited a unity with difference.[45] The Romantics privileged a relationality between the levels demarcated in the fallen world as matter and spirit, where the one could be an allegory of the other, making the levels interchangeable and thus mitigating hierarchy. Near the end of *The Four Zoas*, Orc "consumd himself in Mental flames," prompting "Regenerate Man" to warn about the gods combining "against Man Setting their Dominion above/The Human form Divine" (N9 E 395: 10–11). Should they do so, Orc insists, they would be "Thrown down from their high Station/In the Eternal heavens of Human Imagination" (N9 E395: 11–12). Blake figures the human imagination as both the "Eternal heavens" and the "Human form Divine," from which the gods are exiled for presuming to set themselves above human form. By connecting exile and hierarchy, Blake considers the dangers of isolationism even as he warns the gods that they will be banished from the imagination's Eden. Yet, by placing the human body above the gods, he challenges conventional forms of divinity. Blake warns that Luvah and Vala "Must renew their brightness & their disorganiz'd functions/Again reorganize till they assume the image of the human/Cooperating in the bliss of Man obeying his Will/Servants to the infinite & Eternal of the Human Form" (N9 E395: 14–17). The reorganization of desire and its emanation culminates in the image of the human, which represents a fruitful synergy between will and pleasure.

Ontological simplicity was a goal of reductionism so long as the right level of explanation could be found. Paying attention to the nerves in Blake thus is rewarded by getting to the core of how beings lose connections to the spiritual and

make meaning out of it or, in other words, experience reductionism. Explanatory parsimony, a goal of reductionism, was not a problem within Romantic science for two reasons: one could not seem to be putting a limit upon or doing away with the need for God's powers, since unity ultimately spoke to the design of the universe; and the autonomy of the human could not be replaced by forms of mechanism. Blake's version of unity was grounded in "mutual interchange," not in terms of static essence, and thus the nerves were the perfect locus for imaginative process, especially since, within that interchange, otherness was ineradicable (Clark 181). Hence, he prevents any one character's perspective from prevailing and highlights the potential of reductionism to be a form of totalitarian imposition, especially when the two levels of explanation must lead to identity. Indeed, he describes the worst kind of reductionism as a form of literal shrinkage: in Night 5, for example, Enitharmon "shrunk up all their fibres withring beneath/As plants witherd by winter leaves & stems & roots decaying" (E339: 8–9), transforming others into a kind of *hortus siccus*, dried botanical specimens that are dead. Elsewhere, he links reductionism to murder and embalming, as when Enion murders Tharmas and embalms him in her bosom (N1 E312: 23–24).

This kind of materialist reductionism is called "eliminative" insofar as one of the levels makes the higher level unnecessary, and, as Blake's relentless allegories imply, he had no truck with eliminative materialism because for him that was either Newton's sleep or Urizen's hubris. Tharmas experiences just this kind of reduction and complains that he is "like an atom,/A Nothing left in Darkness" (N1 E302: 43–44). And hence during Night 4, Blake describes Los doing Urizen's work of "the Eternal Mind bounded" (E336: 208). He continues:

> Restless the immortal inchaind heaving dolorous
> Anguished unbearable till a roof shaggy wild inclosd
> In an orb his fountain of thought
>
> In a horrible dreamful slumber like the linked chain
> A vast spine writhd in torment upon the wind
> Shooting paind. ribbs like a bending Cavern
> And bones of solidness froze over all his nerves of joy (E336: 215–22)

As nerves of joy become encased in bone, pleasure is falsely contained. Blake's mounting adjectives highlight feeling's excess, adding an emotional enjambment to his poetic ones. To underscore the absurdity of such containment, Blake not only has an orb contain a fountain but further highlights a "restless" energy that will out. His use of syneresis (as in "writhd" and "paind") underscores the violence

of this reduction.[46] Ernest Nagel argues that "the reduction of one science to a second . . . does not wipe out or transform into something insubstantial or 'merely apparent' the distinctions and types of behavior which the secondary discipline recognizes" (366), and this is suggestive for reading Blake because Urizen's reductions hardly wipe out anything. In fact, reduction to inflexible bones does not eliminate pleasure but only forces it to become secret. Los may joy in the sorrows of Luvah and thus help build the errors of the mundane shell (N2 E321: 3–4), but he will learn the limits of that shell. Blake's metaphors further insist upon the primacy of representation, which allows for a stance vis-à-vis the object represented.

Romantic reductionism, by contrast to Urizen's, offered much wider latitude. Such flexibility was enhanced by the Romantic preference for differences of degree as opposed to those of kind. Unlike differences of kind, differences of degree assert, on the one hand, that difference can ultimately be subsumed under unity yet, on the other hand, that reduction need not do away with difference. To adapt Lacoue-Labarthe and Nancy's framing of Romanticism as "literature producing itself as it produces its own theory" (12) as a way of thinking about the Blake's nervous imagination, I consider how the nerves both name and embody a totality that enacts itself in the very act of embodiment. Lacoue-Labarthe and Nancy are right that Romanticism is about the problem of the subject, the binding together of its infinite sensations, and thus the subject cannot know itself but instead turns to a form and language capable of capturing the problem.[47] The language of nervous organization enhanced the idea of an essential inwardness or interiority too deep for any structure to capture except within an ever-changing or branching organization (Figlio 38). The nerves then allow for the absolute, even as they allow for a future science to make sense of our current reductions.

Because nervous networks emphasized communication and sympathy, the individual problem is transferred to the collective, and only the collective has powers to overcome them. Blake could not have known that the neuron "exhibits both unity and autonomy" (Changeux 11), but he uses nerves in such a way as to anticipate this very problem. As Enion "in gnawing pain drawn out by her lovd fingers every nerve/She counted . . . Her woof begin to animate & not/As Garments woven subservient to her hands" (N1 E302: 20–21). Note that nerves begin as direct objects only to become their own agents, refusing the status of garments and thus subservience. As such the nerves are a metonymy for human communication itself, warning of the possibility of isolationism and alienation.

The Romantic preference for thinking about difference in terms of degree as opposed to kind further helps prevent unity from being imperialist. While degree allows for ultimate unity in the sense of imaginative integration, it ensures that

difference will mean no one thing insofar as unity does not entail the loss of the category of difference itself that is a feature of much analytical reduction, only the loss of degrees of difference. As Donald Ault argues, "Any kind of unity that irreducibly involves closure [in Blake] must, in general, be suspect" (122). Blake's unity therefore is dynamic, whereby difference is continually renegotiated. To wit, in humanity's prelapsarian state, the four zoas exist in every individual: "Four Mighty Ones are in every Man; a Perfect Unity/Cannot Exist" (N1 E300: 3–4). Even within what might look to be perfection, the four exist and negotiate their differences.

My attention to neurology in this chapter further highlights how Romantic science undercuts the historicist equation of the imagination with an evasion of history or with ideology. Far from promoting escapism, the neurological imagination not only insisted on the workings of culture—reading the nervous body as the tracings of that working—but also conceptualized nervous materiality as an emergent form whose organization interacted with the environment to enable an elastic purposiveness.[48] Thus nervous embodiment is essentially dialectic, shaping the inside based on an interaction with the outside, and the Romantic nervous imagination was emphatically the product of a contingent process of biological socialization.[49] Denise Gigante suggests that, "by resisting the predictive value of scientific formulas, living matter kept alive the fortuitous developmental chance: the contingency which entailed not only the chance of going 'wrong' within a system but of veering out of systematicity altogether" (31). Yet, within the science of the time, purposiveness or life was a form of at least regulative systematicity, whose system remains outside the bounds of articulation, and thus must rely upon form to gesture toward it.

Epigenetics, the study of how the matrix of genetic material that shapes whether genes are activated, moreover, has made even biology attuned to the role of environment in shaping development. Neurobiologist Jean-Pierre Changeux explains biological socialization this way: neuronal development is epigenetic, and by this he means that learning and experience superimpose themselves upon the action of the genes, coordinating and organizing development (184–85).[50] He continues, "Connections between neurons are established in stages, with a considerable margin of variability, and are subject to a process of selection that proceeds by means of trial and error" (185). Most crucially, as the organs of sympathy, the nerves implied a kind of embodiment that was contingent upon experience: neurologists of the period wanted to understand how networks could both embody sympathy and explain or deny its selectiveness. Anticipating today's radically embodied cognitive

science, Blake understands "cognition as the unfolding of a brain-body environment system" (Chemero 43), and his proliferating mythology shows how knowledge is irreducibly embedded in context and environment.[51] Why else would Blake proliferate so many versions of the experience of reductionism?

In *The Four Zoas*, Blake could not have done more to contest a reductionism of another kind: the historicist view of the imagination as a kind of ideological escapism. After all, he turns to a dream sequence not to equate the imagination with escapism but to develop an embodied imagination that confronts, rather than avoids, the major ills of his time.[52] In adopting the mise-en-scène of a dream, Blake takes the imagination at its most dangerous and potentially delusional, and nonetheless seeks to get his audience to think about how one knows the difference between reality and delusion. Indeed, forms of the word "delusion" occur twenty-four times in the nine nights, which raises the question, how does risking delusion through dreaming better help us to grapple with it?[53] In a work so concerned with nervous embodiment, Blake, on the one hand, defends the imagination from charges that it engages in merely subjective, feckless dreaming by showing how dreaming becomes a means to knowing, especially when imaginative absorption into imagistic thought loosens the ego boundary (Thompson 112–13), as when Enion pleads with Tharmas to "Make not the thing that loveth thee. a tear wiped away" (N3 E330: 26). On the other hand, readers must always assume Blake's illuminations to be delusions, else one falls victim to imaginative passivity, a kind of waiting for an externally imposed revelation. Here, Urizen's reason imposes its version of reality upon the world in its attempt to fix the image into an embodiment, only to find that its obsession with discipline exacerbates its failures. And, since Blake understands so much of reality to be pathological, pathology no longer separates imagination from delusion. The problem is thus not so much the quantity or degree of imaginative thought—quantity or degree will not indicate pathology—but what that imaginative thought enables one to do. In this view, it is always necessary to assume imagination is delusion, which affords doubt the active process that may eventually lead to procedures for knowing the difference.

As Blake understood it, much of perception is unconscious—what we now know to be dorsal stream activity—while much of imagination is not, because characters can continually report on their imaginative activities.[54] Moreover, the Romantic stance toward reductionism offers science the possibility of seeing the forms of it as aesthetic embodiments even as those forms become amenable to empirical investigation. Viewing it from the standpoint of a unity that cannot betray the absolute enables readers a skeptical stance against the ontology of any

form of reduction, which must be tensed against the explanatory and ideological work of the reduction. Finally, by insistently bracketing what the characters understand to be reality as "delusion," Blake reminds readers to learn not to take any individual phenomenality as reality but rather to look for consensus.

Reductionism is in part about the problem of dealing with what appear to be incommensurate levels of evidence. Philosopher of science Ernest Nagel explains, "In reductions, the subject matter of the primary science appears to be qualitatively discontinuous with the materials studied by the secondary science" (342). When we consider how the various characters in *The Four Zoas* think they are having unique experiences and yet are ultimately battling similar repressions, we understand how reductionism demands the apprehension of what appear to be differences in terms of unity. And yet Blake allows us to see the costs of such unity, for unity would cancel out all qualia, the subjective sense of things, which, in turn, would cancel out the need for his mythological figures to divide and proliferate. At the same time, he shows us characters like Urizen and Los, who have versions of the essential natures of humanity that they attempt to pigeonhole humanity into, along with the practical consequences of those forced versions of nature. Nagel further argues that since these versions of nature are inevitably theoretical, not ontological, they and their implications are not subject to direct inspection: properties and natures cannot adjudicate between various reductions (364–65).

At bottom, I show how scientific understandings of neurology help explain so much of the workings of Blake's *Four Zoas*. I also argue that the flexible materiality within neurology of the time did not force choices between metaphysics and physics: corporeality and spirit were simultaneously possible, and the theory of electricity as an imponderable or immeasurable fluid, thought either to be analogous to nervous force or identified as it, concretized that possibility.[55] In Blake's case, pleasure becomes electrical energy, the circulation of which is akin to life itself. More crucially, neurology was not after the structural limits of the body. Although Thomas Frosch links bodily restriction in Blake to restricted creativity, Blake's dynamic sense of the vital body refuses the notion of corporeality as necessary restriction. Read in light of the neurology of his time, Blake's bodies resist natural limits rather than stand for the constraints of "external nature" (Lincoln 18). That the neurology then stressed function over structure, since so little about the structure was known, meant that intelligibility within neurology was far more important than anatomy. The nerves further allow Blake to reorient sensibility against moral law, since it tries to impose its own versions of which pleasures count and under what circumstances they do so.

BLAKE AND ROMANTIC NEUROLOGY

Neurology of the period helps explain how Blake could believe in this very "Human Form Divine," one organized by nerves. Luvah, or desire, in fact claims that Urizen's attempts to smite him are because "I blotted out/That Human delusion to deliver all the sons of God/From bondage of the Human form" (N2 E318: 16–18). Luvah blots out the idea of human form as necessary bondage. In *Memoirs of Albert de Haller*, for which Blake had engraved the portrait of Haller, Thomas Henry explained that Haller had avoided one of the perils of reductionism—mechanism, which "would destroy one of the proofs of the doctrine of providence" (66)—by turning to laws. He wrote, "Is it not in the wisdom and goodness which the whole of these phenomena announce, and not in the nature of the powers they produce, that we ought to look for proofs of the existence of a superior being?" (67). By deflecting attention from mechanism, which undermined providence, and toward the wholeness glimpsed through laws, Haller could turn to physiological experiment for information without undermining either God's wisdom or the need for imaginative revelation, which Blake considered the very essence of religion. More to the point, by specifying laws as the appropriate level at which to pitch a reduction, Haller made science and theology somewhat compatible. When reduction presented a problem, Haller suggested, think about the right level of analysis, and pitch the reduction there.

George Rousseau comments that, "before the nineteenth century, the 'spirit' is the sign of all the discourses of the nerve" (*NA* 226), and the corporeality of spirit has everything to do with Blake's embodied imagination. Haller's 1755 *Dissertation on the Sensible and Irritable Parts of Animals* defined sensibility as that which "transmit[s] the impressions to . . . the soul" (9). He continues, "In brutes, in whom the existence of a soul is not so clear, I call those parts sensible, the irritation of which occasions evident signs of pain and disquiet in the animal" (ibid.). He thereby allows pain to become a sign of sensibility, even if animals may lack souls. My point here is that Haller helps define the symptoms of sensibility, thereby reducing sensibility to an empirical symptom, but nonetheless allows the gap between symptom and sensibility to frame sensibility as an absolute that can only be gestured toward. Blake no doubt found suggestive Haller's conception of the nerves as being connected to the soul, further collapsing the dualism of mind and body, even as it extends the nerves to the spirit.[56]

On Haller in particular, Rousseau argues that he made the nerves the center of his physiology, claiming its complete dependence upon the nerves (*NA* 229). Nerves are at the center of Blake's physiology as well. Although Haller believed

in an unspecified nerve force, what he called a *vis nervosa*, he remained skeptical of its identity with electrical or magnetic matter (Clarke and Jacyna 162). Although the nerves embodied sensibility, physical connectedness did not explain sensibility. Haller notes, "If a nerve is cut, and irritated below the section, the animal feels no sensation therefrom, which is proof that pain is not propagated from one nerve to another by their anastomosing" (*Dissertation* 24). He concludes, "Wherefore the nerves alone are sensible of themselves, and their whole sensibility resides in their medullary part, which is a production of the internal substance of the brain, to which the pia mater furnishes a coat" (ibid.). Several points are suggestive here. Haller recognizes that the actual connections between the nerves do not necessarily predict how they work together, and therefore embodiment exceeds the literal; specifically, the study of anastomosing, the reconnecting of two streams that have previously branched out, does not enable him to trace the path of propagation of any nervous signal. Haller anticipates the synapse and the fact that nervous connectivity is flexible. Second, he identifies the nervous substance as "medullary," and here the brain was divided into "cortical" and "medullary" substances, the latter of which will become associated with myelination. "Medullary" allows Haller the illusion of localization, but, since he had no idea how medullary matter worked, he could simply skip over the mechanics. In this way, neurology did not demand reduction to a static matter and instead could promote expansiveness.

While Gall did develop the concept of cortical localization in the Romantic period, the confinement of specific functions to specific organs within the brain did not preclude overall connectivity. Gall in fact worried that brain surgery could not remove an organ without affecting the local areas surrounding it (R. Young, *Mind, Brain* 48). Localization did not prevent more holistic accounts of cognition. Even leaving aside questions of nervous structure, those most responsible for the rise in experimental work within neurology—Flourens, Magendie, and Müller—made no attempts to determine the categories of function but instead relied upon traditional ones like memory, reason, imagination, and will (R. Young, "Functions" 257), and this facilitated a collapse between neurology and the imagination. Moreover, rather than allowing the categories of physiological or neurological analysis "to dictate the elements from which the phenomena of everyday life would have to be synthesized," terms of everyday experience like the imagination and memory dictated "how the nervous system must be organized and must function" (R. Young, *Mind, Brain* viii, ix). What this means for Blake's embodied imagination is that he can stress its workings without worrying so much about its structure.

Another reason why neurology could be so suggestive to writers was that neurologists were so upfront in thinking about the problems associated with neurology as a science. How to correlate flesh with mind? Although neurology had proved interconnections between body and mind, neurologists like Alexander Monro II worried about the degree to which the will was in control. Here was his problem: we are conscious of having willed only certain actions—mind is not sole author of functions since we are not conscious of which muscles to use when moving our forearms. He also recognized that sympathy cannot be traced backward; as vastly interconnected and intermixed, actual nervous connections could not quite explain how sympathy could be partial and selective (46). While Gall worried about the costs of reducing mental life to sensibility, irritability, and muscular motion (R. Young, *Mind, Brain* 256), Emanuel Swedenborg admitted that "anatomy dictates nothing more than the probability of our position, and is dumb except in cases of vivisection" (*Brain* 1: 140). By linking anatomy with at best probability, Swedenborg helped encourage epistemological modesty with regard to the brain. Blake at times likewise hoped for such modesty. He worried, for instance, about the arrogance of scientific demonstration, commenting that the sons of Urizen "In ignorance to view a small portion & think that All/And call it Demonstration blind to all the simple rules of life" (N7 E364: 32–33). He implies that demonstration, along with the reductions it requires, at its best can serve as only a metonymy for truth, but only if that demonstration did not violate the "rules of life" here amounting to expansive joy.

Blake's faith in the flexibility of nervous embodiment was perhaps enhanced by John Quincy's *Pharmacopeia Offinalis, or A Complete English Dispensatory*, a copy of which he owned.[57] Quincy framed the workings of the nervous system in both the terms of animal spirits and nervous fluid, refusing to choose between models (71). He further emphasizes how sensitive the nervous system is to the food one eats, and, when blockages were expected, evacuants were prescribed. This is why physicians thought treating diarrhea could help treat madness. When Quincy claimed, "The head hath principle share in agreeable sensations" (70), he may have buttressed Blake's claim that joy circulates in the brain. Quincy had also ascribed the health of the nervous system to "the animal spirits or nervous juice," which are responsible for the "make and contextures of those fine Threads or Fibres" that compose the body (71). The nerves were responsible for emotional health as well: "What is grateful to the Senses gives an inexpressible Emotion to the fine nervous Filaments, so does what is fetid and disagrees quite destroy that Emotion, and deaden it" (87).

Key to that flexibility were electrical accounts of the nerves, accounts that

provided ways of thinking about sympathy and communication through material means, and thus helped to enact a galvanizing aesthetics. Electricity promised to deliver the very secrets of life, and if electricity was not completely reducible to an empirical phenomenon because it was imponderable, or immeasurable, the idea of it explained how nervous conduction could be so fast. Alexander Monro II reasoned that actual connections cannot account for sympathy, since the nervous system was so interconnected. He therefore thought that feeling takes place in the brain (47). Since the known mechanical principles also could not account for nervous action, Monro turned to the concept of "nervous energy," which allowed him to exploit electricity as energy without having to commit to material limits since nervous energy was not yet measurable. Although Blake makes few references to electricity in this poem, he does link pleasure, nervous energy, and life. He defines "war" as "energy Enslavd" (N9 E390: 42), and Vala connects "the forms of Life & of delight" (N7 E367: 37). In Night 9, there are "flames of mental fire." In the context of how the body in the poem is enslaved to fixed forms, Blake suggests continued resistance and nervous energy as the source of that resistance.[58] He further describes Orc as having "consumd himself in Mental flames/Expending all his energy against the fuel of fire" (N9 E395: 1–2). The child of Los and Enitharmon, Orc represents a revolution that pits mental flames against fire, a destructive force that attempts to attenuate its own violence through pleasure. The concept of nervous energy suggests an overall bodily economy where the nerves are essential to life, thus providing a way of thinking in terms of synthesis: wholes, not parts.

Emanuel Swedenborg's voluminous writings on the brain and nerves further expand our understanding of Blakean nervous bodies.[59] For Swedenborg, the brain is defined not so much by its structures but rather by its dynamism, its motions and pulsations: "Not a particle of it is destitute of this motion" (*Brain* 1: 105). He argues, "Every pleasure and every desire conjoined with pleasure, expands the body in general; and contrariwise, that everything hurtful, tormenting and displeasing constricts the body. In the former case there is nothing that compels or takes away liberty; hence comes activity, and this, like heat,—which also consists in the activity of the parts or its aura—naturally produces expansion" (*Three Transactions* 1: 603). Swedenborg connects bodily expansion with pleasure, liberty, and meaningful action; by contrast, pain forces the contraction of the body and the loss of liberty. These configurations are highly suggestive for what Blake is up to in *The Four Zoas* and indeed help account for the manuscript's pornographic illustrations, which aim simultaneously to combat the repression of sexual pleasure and to actualize pleasure outside of discipline. Furthermore, the very joyful pur-

posiveness of living nerves made it possible to interrogate moralizing or instrumentalizing claims of nervous function.

Swedenborg is further instructive in his struggle with how to talk about divine corporeality. Blake's insistence on bodily states—shadows, specters, emanations—may owe something to Swedenborg's insistence on degrees and the relationality between each degree:

> Since spirituality is ascribed to this organic [nervous] fluid, and since nothing physical, mechanical, material, and corporeal is competent to it except as understood analogically, therefore in order to avoid empty disputes originating in mere terms, I might have wished to explain what it is, provided only the ontologist, with the consent of all, justly define what spirit is, what substance, what the simple, force, the immaterial, the pure, matter, and such like terms; and if he cannot do this with the consent of all, that he yet so do it that he himself may know what they are. Let spirit be substance and force; but with these terms of the definition unknown, tell me what spirit is. From the unknown, can aught come that is better known? . . . If it be merely force, if bare thought, tell me what Sensation is, Perception, Idea, Imagination, Sight, Hearing, Modification, etc., without organs, substances, a brain, eye, ear, auras. Separated from these, is such an abstract entity possible in reason? In nature? In the world? Thus as concerns this animal spirit which flows in fibres wherein it is enclosed, and which by means of nerves, moves the muscles, and enters into and constitutes the blood and the smallest part of the body, it is a substantiate, that is to say, it must originate from substance. (*Three Transactions* 1: 730)

In asking the question of how abstraction is to act in the world, Swedenborg points to the necessary materialism of all bodily things. What would imagination be without an organ, he wonders? And yet Swedenborg is especially careful in the kind of materiality he offers: the animal spirits originate from substance, but this does not mean that they are fully substance. His noun, "substantiate," hedges its commitment to substance by temporalizing substantiality to its origin, thereby avoiding the question of what it now is. Swedenborg stresses process, animation, and movement in his account of the brain over any static structures—he thought the brain was a chemical laboratory and thus a site of the combination of chemicals—and Blake underscores process in his account of the nerves. Even more cannily, Swedenborg reminds his readers that the divine can be known only by analogy to the body, but one must not mistake analogy for essence. Although spirituality is ascribed to the nervous fluid—and tellingly Swedenborg does not claim to be doing the ascribing—he modestly limits his claim to an analogical relationship

between spirit and fluid. Furthermore, his invocation of the "ontologist" implies that questions of being are beyond his particular expertise, especially since he wonders whether an ontologist might achieve consensus and sufficient definition.

WHAT THE NERVOUS IMAGINATION DOES FOR BLAKE

In *The Four Zoas*, Blake connects joy with the brain and nerves, and genuine joy results in expansiveness over constriction. Blake's poet figure, Los, proclaims, "Tho in the Brain of Man we live, & in his circling Nerves. /Tho' this bright world of all our joy is in the Human Brain" (N1 E306: 15–16). Localizing joy in the brain and nerves allows Blake to imagine healthy bodies predicated upon the free circulation of pleasure (Luvah) that results in an expansive body that can be so perceived. Blake's sense of how pleasure could be so conducive to generative embodiment anticipates current understandings of brain development. Recently, molecular neurobiologist Jean-Pierre Changeux highlights how pleasure is central to brain development: "Positive reward from the external world results in the widespread release of neurotransmitters such as dopamine . . . [thereby] strengthening or weakening synaptic connections between neurons of the relevant networks" (61). Blake's underscoring of "tho'" insists upon an expansiveness that overcomes obstacles, even as the circle, especially in its gerund form, reminds us of infinity. Pleasure thus is so central to Blake because it is the very basis of bodily divinity and expansiveness, and pleasure is what the nerves do. The road to ecstatic fourfold vision is through the nerves.

Tellingly, Night 1 begins with the "Auricular Nerves of Human Life" (E301: 12), as Enion sits "singing her lamentation" (E302: 1). The ears matter because they are the place where dialogue occurs; David Clark suggestively observes, "Dialogos—a speaking between—displaces Logos" (185), and dialogue matters because the audience is to absorb the collective "Song! Sung at the Feast of Los and Enitharmon." Not only does the song have both call and "responsing" (N1 E308: 4), but Blake also refers to these nerves as "the Earth of Eden." This curious phrase makes the nerves simultaneously material and divine even as assonance solders them together. In a larger view, the dialogue between characters is where understanding becomes possible, but too often dialogue in this test is impossible. Dialogue is prevented because characters form attachments to others yet nonetheless seek to reduce them to possessions or passive objects. Simply put, one cannot dialogue with an object. For example, Enion seeks attachment to Tharmas but then reduces him to a covering for her sins. "I have lookd into the secret soul of him I lovd," Enion announces, "And in the Dark recesses found Sin &

cannot return" (N1 E301: 26–27). Part of what Blake wonders is why human attachment begins optimistically only to devolve into forms of possession and destruction.[60] Finding sin in others is a large piece of the problem especially since another's sin enhances one's pride, leaving no incentive for change and little incentive for genuine intersubjectivity. Even worse, since Tharmas and Enion accuse each other of what each of them are doing, there can be no exchange. With reduction comes the blunting of the senses: "Their senses unexpansive in one stedfast bulk remain" (N5 E339: 19). Blake's illustration shifts our attention from the nervous propagation of sound to the sexual propagation of the emanations, with a cupid figure riding what looks simultaneously like a serpent and a giant penis, and certainly the penis was known to be littered with nerves. By connecting one network of nerves to a second, Blake reminds us of the varying forms of successful propagation; he furthermore puts into play a self-organizing system of networks, a poem whose sum is much more that its manifold parts because the parts are tied to individual perspectives.

When Enion weaves the "Circle of Destiny" or the specter of Tharmas in the first night of *The Four Zoas*, she provides a sustained glimpse into what nervous embodiment does for Blake.[61] Donald Ault has shown how the circle at times appears as a cause, at other times, an effect, and, in so playing with causality, Blake undermines any "Destiny" the circle seems to proffer by "retroactively correcting the reader's natural assumption that the Circle must have existed prior to the action of the poem" (6–7). Visually, this circle is sometimes a crown of stars, a hoop, multiple egg-like forms, or a globe, adding problems of both number and scale. Blake depicts Joy in the "Circling nerves . . . in the Human Brain" (N1 E306: 15–16), and, immediately before he refers to the "Circle of Destiny" for the first time, he describes Enion "draw[ing] out by her lovd fingers every nerve" (N1 E302: 16), thereby making the circle essentially nervous. Read as an image of nervous embodiment in the making, the circle of destiny further ironizes destiny. Enion's very shaping of the nerves into a circle of destiny falsely contains them. Even worse, she intends to "weave" this circle into a "Covering for my Given Sins from the wrath of Tharmas" (N1 E304: 18). When she witnesses "her woof began to animate" (N1 E302: 20), the gap between animation and structure hints that life has a purposiveness of its own. Blake underscores the difference between structure and function by granting the garment "a will / Of its own perverse & wayward" (N1 E302: 21–22). Simply put, the nerves resist the uses Enion seeks to impose upon them, and they become "her own Created Phantasm" (N1 E303: 53). Even she recognizes that in her own phantasm "All life is blotted out" (N1 E303: 47).

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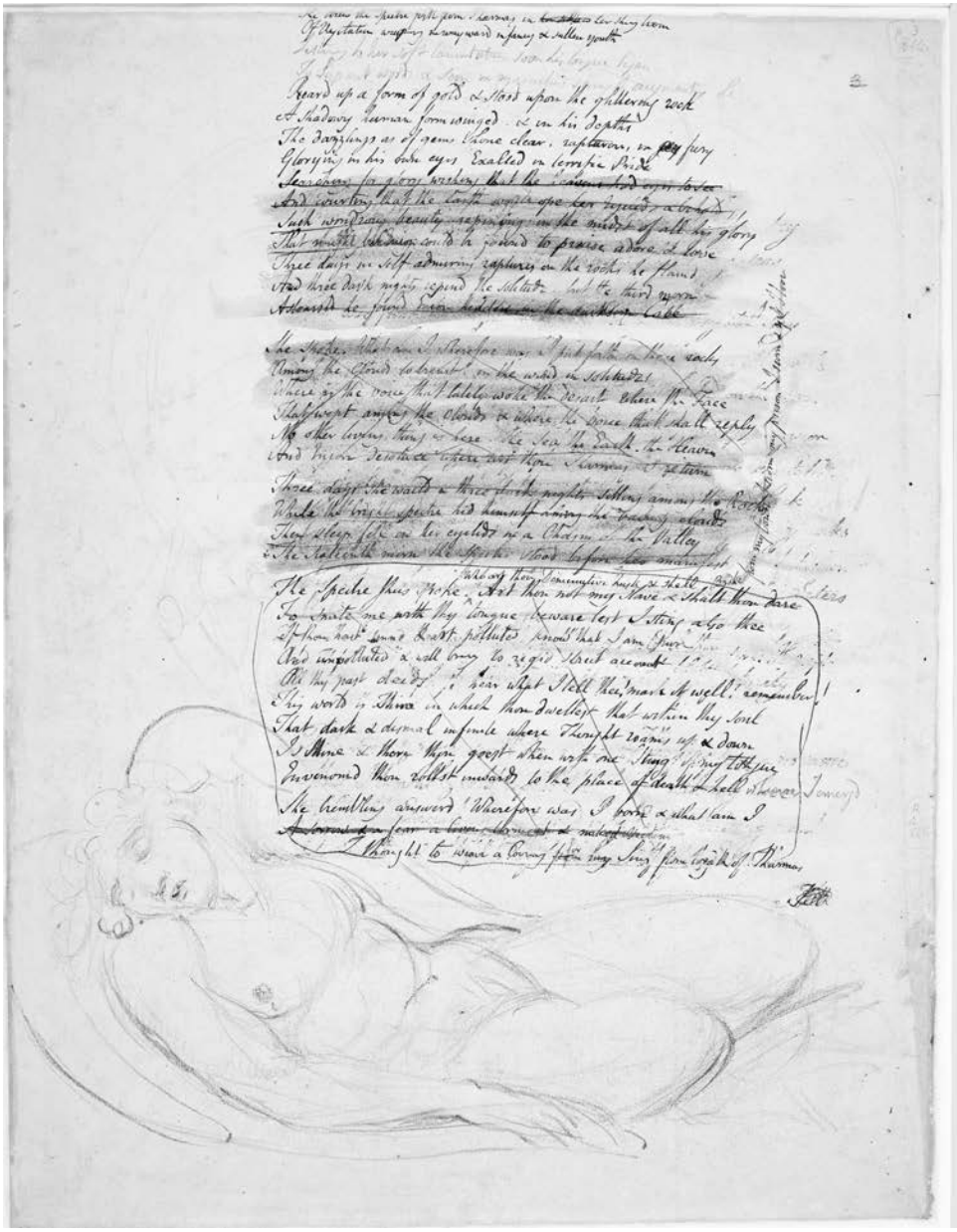
Insofar as the nerves function as a kind of feedback loop, thereby integrating the self with the environment, the ironies behind the circle of destiny mount. If even the boundary between self and environment is continuously shifting, how can destiny be something known in advance? In a late paper published in the Royal Society's *Philosophical Transactions*, Charles Bell argued that "between the brain and the muscles there is a circle of nerves; one nerve conveys the influence from the brain to the muscle, another gives the sense of the condition of the muscle to the brain. If the circle be broken by the division of the motor nerve, motion ceases; if it be broken by the division of the other nerve, there is no longer a sense of the condition of the muscle, and therefore no regulation of its activity" (10). Bell uses "circle" to describe a feedback loop between perception and action, the very openness of the nerves to the information from the world.[62] And yet if the nerves were supposed to conduct information from the outside in as well as generate its own information, Blake anticipates Bell when he has Enion comment, "in this thy world not mine tho dark I feel my world within" (N1 E304: 7). If she begins the line insisting upon the gap between "thy"/"not mine," she ends it by nonetheless claiming to feel her world within. Insofar as the circle of destiny negotiates between the outside and the in, it is a feedback mechanism, albeit a perverse one. The constitution of our faculties and nerves impacts the world we are able to perceive, and Blake underscores their mutual inter-implication in an effort to short-circuit destiny as a fixed destination. Earlier Enion had claimed that the creation of the circle led to the "reversion" of her eyes: "all that I behold/Within my soul has lost its splendor & a brooding Fear/Shadows me oer & drives me outward to a world of woe" (N1 E303: 50–52). Material embodiment is this case leads to the loss of the soul's splendor, a kind of reductionism that Blake and Haller vigorously protested against. Now overshadowed by fear, she loses herself, only to project this fear onto the woe of the world. By implication, when the feedback mechanism is working well and the information it provides is rightly interpreted, the soul should be strengthened.

Although Enion views her work as "complete" with its destiny fulfilled, Blake underscores that her work and destiny are emphatically incomplete, yet to be realized. Enion becomes "Terrified *in* her own Creation" (E303, emphasis mine) and is literally within part of the circle of destiny of her own making, and therefore a metonymy of herself. Furthermore, "A Frowning Continent appeard" in the place of the circle (N1 E303: 26), and Blake's dramatic shift in scale from the individual to the continental points to the absurdity of Enion's vision of completion even as the metonymy works to ironize completion itself. Although Enion would like to continue spreading Tharmas's fibers for examination, Blake's widening of the

aperture to a continental scale makes such a project ridiculous, especially since he reminds us continually that the nerves are always branching because they are an open system. Indeed, by end of Night the Third, Tharmas, through his "thundring sobbing bursting," has "broken . . . the bounds of Destiny" (N3 E330: 10), and the poet's accretion of enjambed gerunds without punctuation intensifies such a break. Complicating matters still further, the daughters of Beulah give "The Circle of Destiny" "a space / And namd the Space Ulro & brooded over it in care & love" (N1 E303: 36–37). By consigning the circle to a material and vegetative world, and by naming this space Ulro, the daughters seek to limit its influence and falsely to impose their version of destiny upon it. Blake's verb "namd" further insists upon the gap between the name and the thing. At a textual level, Blake's narration of the circle of destiny not only has an unusually high degree of erasure and cross-outs, but it is also represented by an image of an angel who may be masturbating. Indeed, the excised text refers to "pollution," and the last words on the verso are "her own created Phantasm." Where is his or her other hand? And what is that dark pencil line near his or her crotch? Perhaps the closed eyes indicate the state of petite mort. Masturbation suggests how solipsistic this loop is. However, that the angel has both hands and wings once again reminds us of the human body divine.

These ironies behind the "Circle of Destiny" help explain why Blake changed the title of this work from *Vala* to *The Four Zoas*; the original title reduces the work to a singular and perhaps hints at the destined triumph of the veils of truth. By altering the title, Blake sought to remind us that destiny was made, not given, and that the nervous system had numerous feedback loops to engage with its environment, so that, as long as life was present, destiny was in the making, not made. When Los unites with Enitharmon, he feels "a world within / Opening its gates" (N7 E368: 7–8) as he literally expands into a world that is itself opening its gates. Provided they are not entirely self-enclosed, feedback loops, moreover, make linear narrative less possible, as the feedback changes, perhaps multiplying, the actual pathways. The fact that the zoas are themselves an amalgam of other entities reacting dynamically to whatever plot elements are present reminds us that they are in essence creatures of nervous sensibility. So too does the fall not have to lead to eternal death, and it is up to Albion to figure out how to regain the vitality he once had. Blake's simultaneous emphasis on localization and metonymy reminds readers that reduction must lead to organization, and that organization has multiple forms. As geneticist François Jacobs puts it, in biology "there is not one single organization of the living, but a series of organizations fitted into one another like nests of boxes" (16), and formally the poem registers this truth.



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Here, the circles of destiny seem self-generating, as there are circles within circles, insistently multiple. The rapidity and dynamism with which they are drawn suggest that they will soon take over the space. Finally, the circles repeat the circles of the figure's breasts, which she holds in her hands, further intimating generativeness and refusing anything like closure.

Up until Night the Ninth, characters experience the fall as a form of reduction of the spiritual to the dead, and reduction is played out in terms of the death of the imagination. Peter Otto captures it this way: "To close one's body in a rigid form is inevitably to confine the active powers that once animated it" (*Blake's Critique* 117). Blake notes, "tygers of wrath called the horses of instruction from their mangers / they unloos'd them & put on the harness of gold & silver & ivory / . . . Petrifying all the Human Imagination into rock & sand" (N2 E314: 3–4, 6). Harnessing of horses alludes to the regulation of the passions, and if harnessing were not enough, there is also petrification. Swedenborg wrote of a "petrified ox brain, which had become as hard as rock—the outer surface was encrusted" (*Cerebrum* 1: 680).[63] Apparently, the ox, whose cerebrum had hardened to the consistency of marble, was an "unusually stupid animal with its head ever hanging down" (ibid.). Like the ox, "the Eternal Mind bounded," "bones of solidness froze over all his nerves of joy" (N4 E336: 1, 14). Urizen at this point stands "in the Human Brain / And all its golden porches grew pale with his sickening light" (N2 E313: 12–13), transforming the imagination into its very opposite and making it ill: a mundane shell. Hence the poet describes the repeated attempts to animate vegetated bodies without imagination, as if all structures can yield are zombies.

The bottom falls out on Night the Fourth as "the Corse of Albion" is reduced to a "Human polypus of Death" (E337: 14–16). "Polypus," of course, refers to an abnormal or cancerous growth, and Blake's implication here is that the loss of divine vision and reduction to materialism is a death akin to cancer.[64] Yet even a polypus is not beyond redemption. Despite Tharmas's degradation, the specter of Urthona protests: "but still I know thee tho in this horrible ruin whelmd" (N4 E333: 28). Blake's emphasis on "whelmd" implies merely the subjective sense of being reduced to dead structures, and the fact that even a specter can still know who Tharmas really is implies that reduction cannot whelm identity. Blake further has Jesus appear "bent over the corse of Death / Saying If ye will Believe your Brother shall rise again" (N4 E337: 17–18). Redemption here is crucially contingent on active belief, the summoning of imagination to compel belief even when evidence for belief would seem to be in very short supply. From Rahab's perspective, Jesus himself is a residue of the body's active powers (nerves), and thus the external savior is potentially always within (Otto, *Blake's Critique* 260).

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In contrast to reductions that seek to dominate and suppress the divine, Blake reminds us that the flesh is no necessary stranger to spirit. One key instance of this spiritual expansiveness occurs when Urizen berates Orc in the Seventh Night of Vala:

> Sure thou art bathd in rivers of delight on verdant fields
> Walking in joy in bright Expanses sleeping on bright clouds
> With visions of delight so lovely that they urge thy rage
> Tenfold with fierce desire to rend thy chain & howl in fury
> And dim oblivion of all woe & desperate repose
> Or is thy joy founded on torment which others bear for thee
>
> (E354: 36–41)

Urizen of course has been doing everything he can to constrict Orc and perceives him rightly in terms of a blissful expansion that threatens his own power. Blake emphasizes his support for Orc formally, by avoiding all punctuation and caesuras in over six lines. Although Urizen accuses Orc of founding his joy on the torments of others, Blake suggests it is Urizen, Blake's poster boy for wet blankets, who is guilty of schadenfreude, and schadenfreude is not to be mistaken for true joy since it is necessarily at someone else's expense. Urizen interprets Orc's joy as rage, perhaps projecting onto him, even as he correctly sees Orc as expansive joy. Blake describes Urizen's imagination as "filled" as he watches Los and Enitharmon's labors: he "saw & envied & his imagination was filled" (N2 E322: 5) with sterile geometric shapes: "Trapeziums Rhoms Rhomboids/Paralellograms. triple & quadruple. Polygonic" (lines 34–35). "Envy" renders the imagination a form of contained mimesis—it becomes an inert container that blindly mirrors—instead of creativity. Blake emphasizes the woodenness of this filling with his staccato use of the ampersand, the inappropriate use of envy as the engine of the imagination because that limits it to passive imitation, and the suggestion that Urizen is just rotely following a list. This catalogue of nonce geometric shapes, moreover, is filled with caesuras, showing the stunting of imagination.

When Blake connects reductionism to the crucifixion, he calls attention to the fact that religious ideas like the fact that Christ has to die to redeem our sins reduce humankind to victims who passively await salvation, despite religion's ostensible connection to spirituality. The Females of Amalek perpetrate the crucifixion, warning:

> If thou dost go away from me I shall consume upon the rocks
> These fibres of thine eyes that used to wander in distant heavens

Away from me I have bound down with a hot iron
These nostrils that Expanded with delight in the morning skies
(N8 E379: 33–36)

Reduction is a form of crucifixion. Expansiveness is framed as part of the past: the nervous fibers that used to wander are now heavily bound. Even worse, as Christ's body is nailed to the cross, "they nailed him upon the tree of Mystery weeping over him / And then mocking & then worshipping calling him Lord & King" (N8 E379: 3–4). The "bounding down" of the body to the cross is itself a reduction of the body to a kind of instrumentality, one made palatable by worship, and the get out of jail free card that his crucifixion implies.[65] These ironies are sharpened by the fact that this description begins at line 33, the age when Christ was crucified.

All is not lost. Despite this binding and petrification, Blake depicts Los's "right hand branching out in fibrous Strength" (N9 E386: 7). Branching, a form of expansion, had previously been associated with the expansion of the nerves. Blake implies that Urizen's/Orc's constriction is ultimately doomed insofar as the nerves now expand under cover instead of openly, and as they do so joy is felt. This hint of failure does not prevent Urizen's attempts to reseal Luvah/lust in his furnaces; in fact, it only makes him more resolute. Yet eventually recognizing that the nerves are self-regenerative and thus resist containment, Urizen and Los accept the futility of their reductions, going so far to rise in joy and "exult," even "exhaling the spirits of Luvah & Vala thro the atmosphere" (N9 E400: 33). "Spirit" here recalls the animal spirits thought to animate the nerves and in terms of the bodily process of exhalation, and this collapse of body and spirit allows the human to remain divine. Blake certainly agreed with pleasure and joy as the bases for bodily health and expansiveness, provided the motivations behind the pleasure and joy were in the name of liberty and not control, and were not merely narcissistic.

Blake could turn to the nerves to embody the imagination because the nerves ideally partook of an emergent embodiment, one responsive to the environment, and not a fixed one. While Blake was apprenticed to James Basire from 1772 to 1779, the official engraver to the London Royal Society, William Cruikshank, published a paper in which he claimed that he done experiments proving that cut nerves had in fact regenerated. Blake may well have known of this paper, read to the society by none other than John Hunter, whom Blake likely knew.[66] By regeneration, he meant "the complete reunion of the nerve after division, and its regeneration after the loss of substance" (Cruikshank 13). In one experiment, he divided four nerves of the first class in the dog and found it dead the next morning. He performed an autopsy that showed one pair of nervous extremities "covered

with a plug of coagulable lymph" (5). He suspected the dog had died because "none of the nerves had yet acquired the power of performing their former offices; and that, were the operations performed at a greater distance of time, the animal would recover" (5–6). In a subsequent experiment, he did indeed allow for more time, and the dog recovered. This led to another experiment where he did not remove so much of the nerves, and upon autopsy performed to look at the nerves, Cruikshank discovered "the regenerating nerve, like bone in the same situation, converting the whole of the surrounding extravagasated blood into its own substance" (7). Cruikshank sees the living body very much in process, and even bone stands not for bodily limits but instead for regeneration, a term that Blake uses to highlight spiritual dimensions of the body. At one point, as if recalling Cruikshank's theory of the development of the nerves from blood, Blake describes "The globe of life blood trembled Branching out into roots;/Fibrous, writhing upon the winds; Fibres of blood, milk and tears" (N4 E338: 24–25). He adds, Blake writes, "his nervous brain shot branches/On high into two little orbs hiding in two little caves" (N4 E336: 20–21). Here the nervous body is under construction, and Blake understands it in terms of dynamic fluidity, one intensified by Blake's gerunds.

In Night 9, Blake alludes to "regenerate" bodies no less than four times, thus perhaps recalling Cruikshank and, in so doing, once again concretizing the human body divine. Although the nerves have the power to regenerate, Blake connects nervous power with pleasure/joy, and thus being responsive to joy enhances true regeneration. Crucially, the poet distinguishes between the regenerations that are imposed on from without—as when "the Lamb of God Creates himself a bride & wife/That we his Children evermore may live in Jerusalem" (E391: 16–17)—and those that are borne from within and then actively pursued. The Lamb does the work of creation, and Blake's "that" implies that the children do nothing but reap the benefits. Here, although the poet understands the nerves to have the potential to regenerate, that potential must be self-activated. Even Ahania actively "cast[s] off her death clothes" resulting in "brightening limbs" (N9 E394: 27). This, in turn, enables Urizen to rise up from his couch "on wings of tenfold joy" (N9 E394: 29). Because Ahania, or pleasure, is Urizen's emanation, Urizen is not just a passive recipient of Ahania's acts. Later, when "Regenerate Man" sits at the feast "rejoicing & the wine of Eternity" (N9 E400: 11), his participation in the feast is a necessary but insufficient condition for his regeneration. The rejoicing is a step in the right direction and can be consummated with the sexual generation that Christ has modeled but cannot do for us.

Surgeon and physiologist John Haighton confirmed the regenerating powers of the nerves in a 1795 *Philosophical Transactions* paper, though he called these

powers "reproduction." Especially suggestive for Blake was his need to reject anatomical judgment concerning the nerves because this criterion "supposes, that anatomy is fully competent to determine, what is the precise structure of nerves, what are the nature and characters of ultimate nervous fibres, and by what mechanism or power they execute their allotted function" (2–3). In the place of anatomical confirmation or nerve reproduction, he proffers the physiological rule "that if the action of a nerve be suspended by the division of it, and if that action be recovered in consequence of an union of its divided extremities, such medium of union must possess the characters and properties of nerve" (4). When he divided the eight pairs of nerves in a dog and the dog eventually recovered, Haighton was "strongly inclined to believe that there must have been a true reproduction of the nerve" (8). He conceded, however, that "if the part of union were examined by an anatomical eye, such reproduction would be very evident. On the contrary, I am persuaded that anatomy can determine only the presence and existence of an uniting medium; but it is the province of physiology to decide whether the medium of union possess the characters, and perform the function of the original nerve" (8–9). In the absence of clear anatomical evidence, Haighton shifts the grounds of proof from anatomy to physiology, with the result that the restoration of function trumps the need for anatomical evidence. He thus made reduction of nervous physiology to anatomy feckless, instead moving things to the higher level of physiology to preserve autonomy. Haighton confirms "his distrust of those decisions founded on an appeal to the eye, seeing that anatomy has yet to explain by what mechanism or structure these organs perform their office" (10). The poor dog, having survived nineteen months, had his nerves divided again and dissected so that Haighton could prove "the nerves are not only capable of being united when divided, but that the new formed substance is really and truly nerve" (11). Haighton shows the nerves to be capable of regeneration, and, as such, science helps to confirm Blake's sense of divine corporeality insofar as flesh regenerates and eventually attains fourfold vision.

Narrative weaving in *The Four Zoas* thus mimics the kind of branching nerves undergo. Unlike Peter Logan, who sees narrative as a pathology of the nervous narrator, I underscore the generative possibilities of the nerves in Blake, which expands the imagination rather than dooming nervous speakers to endlessly recapitulate their disease. At once the narrative of the eternal death of Albion and his resurrection, the reader is often uncertain of which direction the narrative is headed. Blake is after alternative narratives. Formally, he enacts expansiveness through epic-like catalogues that list entities demanding some kind of narrative thread that pulls them together. Donald Ault rightly argues that "the implicit goal of Newtonian

narrative is imaginative death through positive affirmation; the explicit goal of Blake's narrative is an intense awakening, through narrative dialectic, to hitherto buried possibilities of the human imagination" (4). I add simply that this awakening is made possible by the nerves, which further enable the experience of joy. Moreover, since fourfold vision is something like incomprehensibility—Blake describes the "Four Wonders of the Almighty/Incomprehensible" (N9 E393: 258–59), which of course are the four zoas—the reader's imagination must confront its own exhaustion only to engage in more active branching in hopes that new connections will somehow make the whole more comprehensible.

Seen in light of nervous embodiment, family thus is not so much a given network as a constantly renegotiated set of interconnected relations. Tharmas confronts Los, shifting subordination into dominance but in the process becoming the dominance he abhors, as when he orders Los to rebuild the universe (Night 4). Enion thinks her children, Los and Enitharmon, are "ingrates," and this resentment is the cause behind the children's development of a "dread repulsive power" (N1 E304: 4). This family dynamic is the nursery behind "embryon passions" (N1 E305: 25). When Enion can see past her resentment, she eventually learns that "In families we see our shadows born. & thence we know/That Man subsists by Brotherhood & Universal Love" (N9 E402: 21–22). To cite another example, eternal man mistakenly begs the Prince of Light to save him, but "the deep buried his voice & answer none returned" (N9 E389: 26). And he will get no answer until he learns some self-reliance. With reduction, spirit separates from body, the two sexes divide, and, as characters impose domination upon each other, requests become orders. As children mature, however, the model of obedience becomes less and less adequate.

IMAGINATIVE DELUSION VERSUS KNOWLEDGE

Thus far, the free circulation of pleasure and energy would seem to indicate health. The problem, however, is that corporeality, even expansive corporeality, cannot speak for itself. The meaning of its feltness must be articulated, as there is no one necessary meaning to any one feeling, and certainly no necessary one-to-one correlation between a feeling and an action. This is why Blake insists that absolute reduction to physicalism fails: the physical always has a feltness that is being interpreted. Not only are vitalism and sensibility resistant to physical reduction, but also context is an all-important index of meaning, especially since it points to states of intentionality, which derives from the meaning the person imposes upon the objects of his or her perception. If expansiveness and continued creation are

the goals, not every form of expansiveness and creativity will do: some forms of expansiveness are really delusional, and one major goal of *The Four Zoas* is to teach readers how to distinguish actual healthy pleasure from delusion.[67]

At the simplest level, the clearest signifier of delusion is rigidity or absolute reduction. Thus, at the start of the fifth night, Urizen "infected Mad he dancd on his mountains high & dark as heaven / Now fixd into one stedfast bulk his features stonify" (N5 E338: 1–2). While watching Urizen, Enitharmon becomes what she beheld, feeling "her immortal limbs freeze stiffning pale inflexible" (N5 E339: 6). Although many thinkers consider materiality to refute delusion—if something is materially present, how can it be a delusion?—Blake is interested in the ways in which materiality acquires the power to delude others of its perdurability and inevitability. Take his description of Urizen, "sitting in his web of dece[i]tful Religion" and "feel[ing] his pores / Drink in the deadly dull delusion horrors of Eternal death" (N8 E381: 18, 20–21). What does Blake mean when he describes Urizen feeling his pores drink in the delusion of eternal death? The porousness of the body and its openness to delusion is figured in the form of a felt material encounter. As he becomes stupefied, delusion enters the skin, and Blake's consonance gives it a drumbeat as it enters the ears. Characters regularly forget that the materiality before them does not equate to inevitability. By that, I mean that Blake underscores how the way one thinks changes how one views material objects and thus alters the kinds of encounter with them that seem possible and what those encounters mean. Indeed, *The Four Zoas* show us how others react to encounters, and in the process suggests that we can learn from their many mistakes. Tharmas and Urthona now begin to feel "the stony stupor rise / into their limbs" (N8 E382: 21–22), but Tharmas now "gave his Power to Los, [while] Urthona gave his strength / Into the youthful prophet for the Love of Enitharmon" (N8 E383: 31–32). Enitharmon weaves "soft delusive forms of Man," and Tharmas here to his ample credit recognizes those forms as delusions (N4 E332: 6) and thus refuses to accept them. Erasmus Darwin, by contrast, called insanity the tendency to "mistake ideas of sensation for those from irritation, that is, imaginations for realities" (Z 2: 356–58).

Although Swedenborg celebrated bodily expansiveness, Blake shows that expansiveness is not in itself a necessary good. One therefore has to look into the causes of expansiveness so expansion can be evaluated. On occasion, expansiveness can poison even felt pleasure. Although the illustrations to Night 3 indicate the appearance of sexual freedom and nudity, Blake inserts this caution: "till these dens thy wisdom framd / Golden & beautiful but O how unlike those sweet fields of bliss / Where liberty was justice & eternal science was mercy" (N3 E327: 9–11).

On the one hand, the dens frame wisdom, giving wisdom something to concentrate on. On the other hand, although these dens appear "Golden and beautiful," Blake brackets these adjectives by "but." These golden fields are furthermore "unlike those sweet fields of bliss." Blake's poetry therefore must repeatedly rethink true expansiveness—hence, he insistently distinguishes between delusional and imaginative pleasure—until something like a nonhierarchical dynamic unity is achieved, one that preserves difference. And since context is what helps explain why some pleasures are to be valued more highly than others, Blake immerses readers in context. Even Los gets it wrong when he takes pleasure in the sufferings of Luvah.

Vala herself symbolizes natural delusion. Associated with veils that hide the truth, Vala is only the partially erased main protagonist of *The Four Zoas*. In this way, her departure itself is a visual absence but not necessarily an actual absence. And yet what is Blake doing by embodying the imagination in the nerves and at the same time seemingly warning against the kinds of delusions that Vala's embodiment represents?[68] Since both are embodied, what is the difference between imagination and delusion? How is the reader to distinguish the kind of embodiment Blake approves of from the kind of false embodiment that Vala represents? Blake opens *The Four Zoas* with, "[What] are the Natures of those Living Creatures the Heavenly Father only/[Knoweth] no Individual [Knoweth nor] Can know in all Eternity"? (N1 E301: 7–8). Thereby he suggests that the problem is unsolvable. However, attentive readers learn to be skeptical of appearances that are framed as reality and to apply that skepticism to all forms of embodiment. The trick is to consider what the embodiment leads to, and then to make the warranted causal claim. Embodiment that stonifies is a sure sign something is awry. Emotions further offer important clues, especially since despair is often the outcome of constriction. Characters, moreover, are motivated by different emotions, most commonly, jealousy, envy, pride, wrath, fear, and pity, and these emotions not only correlate to intentional states that undermine reductionism but also paradoxically serve as the very drivers to reduce others to fixed states, especially those that see fallenness as irredeemable.

Luvah mistakenly thinks his mission is "to deliver all the sons of God/From bondage of the Human form" (N2 E318 : 17–18), but rightly perceives the human form poses no necessary bondage. Blake later notes that "For without a Created Body the Spectre is Eternal Death" (N7 E369: 38). The delusion that the human body is limited leads to a rejection of the body and to the ideal of transcendence, and Peter Otto has ably documented how Blake fights religious transcendence because it defers salvation to the afterlife (*Blake's Critique*). Though Blake has been charged with faulty Greek in pluralizing "zoas"—the Greek *zoa* is already

plural—I suggest that it is precisely this kind of expansion that Blake harnesses to prevent a stifling unity. After all, he numbers multiple eternities, proliferates eternal men, and the zoas physically embody those eternities.

Earlier Blake describes an even more intoxicating delusion. His interest in how delusions become attractive makes him think in terms of the psychological incentives for believing delusions, and, thus, if a delusion becomes someone one wants to believe, one can perhaps choose *not* to believe it:

> The Man ascended mourning into the splendors of his palace
> Above him rose a Shadow from his wearied intellect
> Of living gold, pure, perfect, holy; in white linen pure he hover'd
> A sweet entrancing self delusion, a watry vision of Man
> Soft exulting in existence all the Man absorbing (N3 E327: 2–6)

Purity, holiness, and gold make for enticing viewing, and man's ascension further suggests Blake's endorsement. However, that purity, rather than standing for a larger whole, is merely part, a shadow of his wearied intellect. If metonymy advertises a substitution that explicitly fails to substitute, the poet underscores self-delusion. Man's devolution into watery softness offers another warning sign. Man's later declaration that he is nothing in the fact of God further frustrates Blake, as man has forgotten his own divinity, preoccupied as he is in being saved and merely being passive. This is why he makes the Lamb of God the creator of the conditions for eternal death (Ault *Narrative* 269), and not just the savior. Nonetheless, the fact that so many characters actively seek self-delusions means that delusion is only a partial denial since one should not fully be deluded by the delusions that one actively seeks. If delusions are partly willed, logic implies they can be unwilled. The key then is to see the part the self plays in the delusions it adopts, and why it adopts them.

In order to teach his readers how to learn the difference between delusion and reality, a difference exacerbated by the fact that delusions regularly acquire material form in Blake, he encourages his audience to think contextually and beyond linear time. Acts have consequences, but they so rarely lead to the consequences intended, and this means that in acting one should not assume a linear path between intention, act, and consequence. Crucially, others are never just the tools of our intentions. Because nerves are places of embodiment where emotions allegedly roost, they somehow contribute to intentional states. Blake envisions emotions as pointing perceptions into actions, but too often characters are motivated by either selfish or cruel feelings, and indeed "delusive cruelty" is an insistent phrase. Furthermore, as Urizen builds his altar with the "labor of ten thousand

Slaves," Enitharmon with "her caresses & her tears revivd him to life & joy" (N2 E320: 39, 47). Yet instead of perpetuating this life and joy, they build the mundane shell, "plant[ing] divisions in the Soul of Urizen & Ahania" (N2 E322: 3). The problem is that Urizen has learned how to delight in another's pain. Moreover, Enitharmon feels "strong vibrations of fierce jealousy" (N2 E323: 45). Vibrations allude to David Hartley's argument that the nerves work through vibratiuncles. Jealously causes her to think that Urizen is hers, "created for my will, my slave" (N2 E323: 46), but not even Urizen can be her possession. By making actions and emotional reactions the only engines of plot, Blake makes it impossible not to think about actions contextually, since context rather than fixed interiority provides what interpretative clues we have. This means that linear causality will always be insufficient, in part because it cannot account for how we are always modifying our sensations with memory and information from the environment; moreover, memories are tied to emotional states that trigger the recall of it, thus shaping it to fit a larger narrative. It is perhaps not too far from here to leap to Gerald Edelman's idea that the brain works through a process of selection guided by values imposed in the brain (*Remembered Present*). Enacting plans, moreover, changes the causal relations between objects (Edelman, *Bright Air* 169).

Perhaps nowhere is context more important than in the poet's giant tumescent phalli (see manuscript pages 40 and 41, in Magno and Erdman 46–47). The mere presence of pleasure, in this case genital erection, is no sign of progress in itself, insofar as Blake describes Albion as "idolatrous to his own shadow." Desire is reduced to selfishness and even a form of false self-worship. Although expansion would seem to defy moral law, in point of fact it serves only to eroticize it insofar as the taboo makes it seem sexier. That Blake depicts Vala masturbating a large penis to the point when "the balmy drops fell down" (N3 E327: 1) only serves to underscore that "rent from Eternal Brotherhood we die & are no more" (N3 E328: 9). Blake's truncation of Albion's legs recalls William Hunter's anatomical drawings depicting the human body as a butchered piece of meat, thus further indicting a pernicious reductionism. Blake makes the context for evaluating acts communal, since ideally pleasure is a unifying experience. He insists, "Man liveth not by Self alone but in his brothers face/Each shall behold the Eternal Father & love & joy abound" (N9 E402: 25–26). Blake's subtle expansion of "bound" to "abound," heightened by his enjambment, aggressively curtails any reduction.

Materiality so often leads to the desire for possessiveness, and Blake's point is that the material eludes possession. Properly understood, the material body expands beyond whatever contains it because it is dynamic. When the container of eternity is filled, Blake moves to the next eternity. His notion of unity further avoids

totalitarian imposition by paradoxically holding on to difference. To wit, Tharmas understands himself to be "like an atom/A nothing left in darkness yet, he proclaims [he] is an identity" (N1 E302: 43–44). How can nothing have an identity unless it is differentiated from its surroundings? To return briefly to Enion's possession of Tharmas, I underscore how Blake highlights the consequences of characters being reduced to tools. When Tharmas returns the favor by raping Enitharmon (N4 E332: 4), Blake shows how the cycle of violence perpetuates itself and how woman's status as property encourages violence. When Tharmas "balm[s] her bleeding wound" (line 6), he recognizes his guilt.

Blake denounces as delusion pleasure that leads to domination, obedience, pity, jealousy, envy, and fear, calling war the result of the repression of energy. Urizen accuses Los of being "the soft delusion of Eternity" (N1 E307: 25), but the fact that he "collected in himself in awful pride" hints that his accusation of delusion is the delusion. Los later asks "why can I not Enjoy [Enitharmon's] beauty" (N7 E357: 23), blind to the fact that "his jealous lamentation" is itself the cause. He sees her "thrilling joy in beaming summer loveliness" but cannot feel it, and the gap between seeing and feeling is a space from which one can suspect delusion is at work since genuine pleasure should have no delay. The fact that Los "felt the Envy in his limbs like to a blighted tree" (N7 E353: 27) hints that physiology helps us grasp what the emotions mean, especially when they become associated with illness. Illness marks the feeling as ugly.[69] Orc knows that "the arts of Urizen were Pity & Meek affection/And that by these arts the Serpent form exuded from his limbs" (N7 E363: 11–12). Pity and meekness have the power to thus delude attention away from the serpent form; Blake thus labels them "arts," thereby dissociating them from sincerity and making them a potential screen for manipulation. Those arts then need to be distinguished from Blake's art. The reader's role is to learn the difference between Urizen's delusive arts and the poet's, and the problem is that Blake's art always risks delusion. Fear causes love to recede: Enion remarks, "All Love is lost Terror succeeds & Hatred instead of Love" (N1 E301: 18).

Although characters may have to resort to secrecy in order to subvert, secrecy ultimately poses a problem because it enhances repression and threatens to make pleasure into a delusion. Urizen builds a temple in the human heart. "They formd the Secret place reversing all the order of delight/That whosoever enterd into the temple might not behold/The hidden wonders allegoric of the Generations" (N7 E361: 2–4). Blake emphasizes restriction here; those who enter the temple are blind to the wonders of generations. Although hiding is a reasonable response to repression, ultimately Blake thinks that it adds to repression. Why else would he claim that secrecy has the power to reverse "all the order of delight"?

So do purity and righteousness signal delusion. On Night the First, Tharmas's specter demands of Enion:

> Who art thou Diminutive husk & shell
> If thou hast sinnd & art polluted know that I am pure
> And unpolluted & will bring to rigid strict account
> All thy past deeds. (N1 E303: 9–12)

That a specter accuses Enion of being a husk and shell is unintentionally funny. Even worse, the identification of the self with purity leads to judgment rather than intersubjectivity, for the "pure" individual not only wants nothing to do with pollution but counts on the sins of others to maintain distance and feel better about herself. And yet Blake's point is that this arrogance and superiority is itself a form of pollution, especially since purity both so desperately needs its opposite to keep its sanctity and is completely unaware of the possibility of self-criticism. Hence, he couples righteousness and doom (N3 E330: 20). Likewise, when Urizen urges his daughters to "let Moral duty tune your tongue / But be your hearts harder than the nether millstone" (N7 E355: 40–41), the fact that hearts are required to be hardened in the name of duty signals something awry. Blake then links this to the evaporation of Los and the compulsion of the poor "to live upon a Crust of bread by soft mild arts" (N7 E355: 9). Living in dire poverty, Blake would have known what this was like, with the added problem that if bread was used to wipe excess ink off his copper plates, the crusts would be useless. The mere fact that purity must be known to others undermines the very existence of purity, since the show becomes more important than the worth of any deeds. It also explains why priesthood lends itself to "dark delusions of repentance" (N8 E382: 18). As the previous example already suggests, the presence of pride further promises delusion. Tharmas's specter is "exalted in terrific Pride" (N1 E303: 8). Similarly, pride makes Urizen think "himself the Sole author / Of all his wandering Experiments" (N7 E356: 1–2). Finally, Los "in furious pride [with] sparks issuing from his hair" (N4 E332: 11) hopes to drink up the Eternal Man. "Sparks" hint at the electrical nerves, which thankfully have been able to retain their nervous power.

Fear also often invites delusion. Urizen constantly fears his son, Orc, and as a result does everything he can to destroy him. Enion can be redeemed only when mankind loses its fear of death. At that moment, she becomes a loving mother, sacrificing herself for others. Blake argues that regeneration is possible when one confronts eternal death by facing one's fears.

Despite providing these indications of delusion, Blake recognizes that the gap between imagination and delusion is a fine one. Hence in Night the Eighth, he

depicts the Council of God viewing the divine vision, except that it is not clear where the divine vision begins and ends. Does it include Urizen's "Engines of deceit" which "pervert all the faculties of sense" (N8 E374–75: 15, 20)? Does it include the birth of lust (N8 E375: 28)? And does it include the appearance of Satan's "Vast Hermaphroditic form" (N8 E377: 21) or Ahania's speech, which encourages deism and natural religion? The answer is yes to all these, and Blake's implication is that even these satanic embodiments are also forms of the divine. He provides an important clue when he insists, "Where Death Eternal is put off Eternally / Assume the dark Satanic body in the Virgin's womb" (N8 E377: 12–13). Blake's verb "assume" hints that satanic form is mere appearance. Moreover, not to insist on this gap between imagination and delusion would mean that salvation has been achieved and that imagination has no work to do.

Although Enlightenment psychiatrists and neurologists generally sought to make delusions stand unambiguously on the side of madness and often turned to physical explanations like the actual compression on the nerves to explain delusions, Blake thinks the causes are not physical but psychological.[70] John Hill was one exception: he thought that "vain sensibility and wanderings of the mind could be cured by "command of the imagination, which we call presence of mind" (*On the Construction* 46). Blake agrees that command of imagination is both possible and potentially beneficial. For him, the only guarantee of the end of delusion is what Blake calls in his penultimate line, "intellectual War The War of swords departed now" (N9 E407: 9). Although redemption entails the end of physical war, intellectual war nonetheless remains. With pride and purity especially, there can be no intellectual war, as the self does not doubt itself. There is also the problem that seeing one's enemies in terms of delusions can be comforting. Noting Los as a threat to his power, Urizen asks of him, "Art thou a visionary of Jesus the soft delusion of Eternity" (N1 E307: 25). By framing Los as a visionary of a delusion, Urizen attempts to dismiss him into the ether. Blake, however, emphasizes Urizen's false and erroneous bravado when he has Urizen thump his chest and declaim, "Lo I am God the terrible destroyer & not the Saviour" (N1 E307: 26). Just as Urizen sought twice to desubtantialize Los, he twice insists on his own identity, both in terms of what he is and what he isn't, a fraught form of masculine identity. Urizen also cannot resist decapitating Los, the poet figure, into the empty gestural interjection, Lo.

Implied in his understanding of a fine line between imagination and delusion is Blake's awareness that even reduction and contraction can have positive uses. In "Great Eternity," humankind gains powers of perceptive expansion and contraction at will: "Then those in Great Eternity met in the Council of God / As one Man

for contracting their Exalted Senses/They behold Multitude or Expanding they behold as one" (N1 E310–11: 16–18). Contraction and expansion in eternity are essentially perceptive; moreover, by making unity the work of contraction/reduction, Blake undemonizes what is in the fallen world demonizing. Urizen's furnaces exist to constrict, and Blake's point is to remind readers that Urizen and his ilk must work extraordinarily hard to constrict what is in essence expansive in nature. Expansion is a way of thinking about joy in spatial terms; and, in here revaluing constriction as a way to perceive unity, Blake reimagines an expansiveness that ideally becomes a form of willingly self-imposed constriction, so that all can appear as unity. The upshot is that even constriction is not necessarily evil, and the added implication is that qualities that seem irredeemable are not so. The crucial difference is that this constriction of vision is self-imposed for the right reasons.

If imagination and delusion are less far apart than the culture maintains, then the distinction between them will no longer serve as a clear indication of madness. Blake challenged the Enlightenment discourse on delusion because delusions were not intrinsically pathological—having a delusion did not mean automatic madness—but, on the one hand, delusions were caused by a power structure that cultivates delusions like moral law and purity to reinforce hierarchy and priesthood, and, on the other hand, they were caused by wish fulfillment and by not being able to see the differences between what one wishes to be true and what is true. He argues that there are forms of delusion like moral law, which most people subscribe to, because it feeds their need to feel superior. Thomas Arnold in his *Observations on the Nature, Kinds, Causes, and Prevention of Insanity*, for instance, called a delusion "the possession of a supposed excellency" (176). Even Los kindles Enitharmon's "delusive hopes" (N2 E324: 94). Hence, Urizen and Los force bodies into versions of fixity and delude themselves that this is working. Blake therefore realizes that the only way to protect oneself from delusion is to always worry about the potential for self-delusion. Even delusions can be a vehicle to self-knowledge, if only one can figure out why the delusion is attractive to begin with.

In a work about the knowledge that comes from dreams, therefore, Blake uses forms of the word "delusion" twenty-four times in the nine nights, thereby normalizing delusions and insisting on the ability to demarcate delusions from truth. Is a delusion something that has not yet been proven true? He thus insists that readers always factor in the possibility of delusion. Blake also recognizes the degree to which poor self-knowledge contributes to delusions; Urizen after all insists that he is doing moral good when he is destroying imagination and pleasure. Imaginative folks required more vigilance; Thomas Trotter argued that because of their "deluded and vivid imaginations . . . nervous people are capable of believing any-

thing" (238). When delusions no longer imply pathology, it is easier to think about why one is attracted to them; it is also possible to consider the psychological benefits of an idea that make the delusion attractive. It becomes possible to think about the versions of selfhood delusion underwrites. In fact, immunity to delusion requires a Goldilocks devaluation of selfhood: not too much to be a lack of self-confidence and not too little so as to be seduced by purity or pride. Hence Blake's just-right insistence upon a paradoxical self-annihilation without a loss of self, since the tension between the two is what prevents the extremes at both poles.

Blake's awareness of the costs of reductionism makes him define self-annihilation against the developing scientific form of it called "objectivity." Lorraine Daston and Peter Galison argue that objectivity is a denial of subjectivity, a kind of will to willlessness that replaces the subjective with disciplined observation. From Blake's perspective, not only does objectivity distance oneself from one's emotions, and thus make oneself powerless to think about the psychological benefits provided by delusions, but also objectivity hardens things into objects, so that they can be appropriated and the appropriation seem justified. Like reductionism, objectivity makes it easier to impose one's will on the world. By contrast to objectivity, Blake's notion of self-annihilation is at once deeply subjective—it comes at a painful cost to the self, and the self is acutely aware of the sacrifices it is making.

Blake further challenges the idea that delusion equals madness by recognizing how attractive the condition of forgetfulness is and by having his characters choose states of "oblivion" that make them unable to resist reductionism. Not only do characters regularly attempt to go into hiding, which has the preliminary advantage of escaping surveillance, but also characters deliberately withdraw into forgetfulness. Thus, when Urizen finds that his binding of Orc isn't working, he "hid to recure his obstructed powers with rest & oblivion" (N6 E348: 10). If oblivion can be a tactical choice, then memory is selective, even creative, and is based on values.

For Blake imagination and delusion are so intertwined because the roots of delusion are either experience or belief, and it is not clear how one leads to another. The imagination is the nexus where experience amounts to belief or belief shapes experience, and the nervous imagination is where emotion tinges both experience and belief, lending both a reality effect. By having perceptions that are already emotionally freighted, Blake blurs the ground between perception and belief, and makes perceptions into prompts to action. Thus Orc's energy is enflamed by Urizen's binding; Urizen's binding of Orc is based on envy, and because of his envy, Urizen will instruct his daughters to "over all let Moral Duty tune your tongue" (N7 E355: 3). The two will goad each other into conflict until one of them recognizes that the mutually defeating pattern harbors delusions and invents a

new paradigm. Orc is, after all, Urizen's son. The goal, then, is to try to change either the emotion or the meaning made of it, as the nameless shadowy female does when she meets Orc's wrath with meekness, hoping to temper it. Such rapprochement opens the possibility of "unit[ing] in one, another better world will be / Opend within your heart & loins & wondrous brain / Threefold as it was in Eternity" (N7 E368: 43–45). Note, however, that, even within unity, Blake describes threefoldness, implying the preservation of difference even within this unity even as the holy trinity is sexualized. The pronoun "your" marking the other's organs and brain further insists on difference. And there is presumably a fourth level to go.

The ending of *The Four Zoas* reminds the audience that one can always move from the constriction of night and into Enlightenment, that it is possible to gain control over one's delusions:

> And Man walks forth from midst of the fires the evil is all consumd
> His eyes behold the Angelic spheres arising night & day
> The stars consumd like a lamp blown out & in their stead behold
> The Expanding Eyes of Man behold the depths of wondrous worlds
>
> (N9 E406: 22–25)

In this imagined divine vision, Blake's use of metonymy is nothing less than extraordinary and works to make eliminative reductionism absurd. If absorption into image through the imagination reveals the self as limit, the poet's sliding scale puts front and center the limits of perspective. By literally surrounding the stars with human eyes that are expanding, he highlights how perception shifts reality even as he figures the stars as eyes beholding human eyes beholding wondrous worlds. Blake achieves something like the perspective of infinity in the shifting scales of eyes, lamps, and stars; for the one to be perceived as the other, scale itself must be shown to be a limit to perception, and, by logical extension, imagination must expand beyond the self, as it does when one is absorbed into the image. His decision to illustrate expansiveness through both the figure of metonymy and the fourteeners that acquire extra syllables, however, sets into motion colliding scales, which arrest the dissolution of self through the insistence on perspective. This ability to shift perspective, to see unities despite differences, makes it possible to resist delusion's seduction that one is better than or holier than someone else. To that end, the passage performs a simultaneous annihilation of the self without getting rid of the self, for the vantage point remains front and center even though the scales shift and the relentless enjambment threatens to swallow each individual line. Of course, the walking in the midst of the fires that consume evil allegorizes Blake's printing process and his use of acid, and this reminds us that what we have

here is no distant vision but something taking place as readers consume the poem and it becomes part of us.

I have shown how the science of the nerves in the Romantic period enabled Blake to reduce the imagination to the nerves without getting rid of spirit or consciousness or autonomy. At the same time, too much autonomy comes at the expense of community. The concept of nervous organization made ample space for spirit and autonomy from mechanism. In *The Four Zoas*, Blake pits a flexible reductionism against an eliminative reductionism. The former, because it understands difference allegorically and does not attempt to get rid of it, is compatible with mutuality. The latter enhances domination and hierarchy. As the organs of pleasure, the nerves are crucial to Blake, for they explain why a healthy body relies on a free circulation of pleasure and situate that pleasure in a larger communal context. Against historicist treatments of the imagination that reduce it to ideology, Blake actively thinks about the fine line between imagination and delusion, and ultimately argues that one must always be on guard because not only might one's imaginations be delusions, but also collective delusions like moral law, priesthood, and holiness simultaneously enhance one's own passivity and disenfranchisement along with the illusion of one's superiority. *The Four Zoas*, then, is simultaneously a plea on behalf of consciousness and autonomy notwithstanding the neurological self and a warning that autonomy must not be taken as given but actively maintained yet tethered to community so division doesn't become divisive. It is also a plea for an imagination not merely subject to the understanding, as Kant understood it, insofar as Blake shows the ways in which even delusions can enhance understanding, because they are often, at bottom, about the misguided need to aggrandize the self at someone else's expense.

CHAPTER 3

The Physiological Imagination

Coleridge's Biographia

On the way to his famous definition of the imagination in the *Biographia Literaria*, Coleridge proclaims, "It would be an act of high and almost criminal injustice to pass over in silence the name of Mr. Richard Saumarez . . . the author of 'a new System of Physiology'" (1: 162).[1] Why does physiology matter to Coleridge's theory of imagination, so much so that not to mention Saumarez would be "criminal"? And what can physiology and Saumarez tell us about the imagination and *Biographia* that we do not already know? A great deal, it turns out.

Coleridge defines the imagination as "essentially vital" (*BL* 1: 304), thereby framing it physiologically. Not only did physiologists of the time understand that the imagination was part of how minds work, but they were also obsessed with vitality. Charles Bonnet, to cite only one of dozens of possible examples, tried to work out how ideas excite the soul and therefore considered the imagination as "the physical cause" of "the reproduction of ideas" (*CN* xxxvi). Georges Cuvier, whose work Coleridge greatly admired (Levere, *Poetry Realized* 77), thought "the susceptibility of the nervous system [itself was] governed by imagination" (2: 120). Hence, physiologists could use imagination to put together a physiological science but only if reason and imagination could cooperate. Such cooperation was all the more necessary given that life was the main problem of Romantic physiology. Because vitalism—the theory that life could not be reduced to its chemical and physical components—posited a teleology beyond mechanism, the question was, how could it be made more than something imagined? Physician Anthony Fothergill called the principle of vitality "a mere phantom of imagination" (11) because it could not be localized, and Fothergill underscores why vitalism and imagination could share the same fate.

For physiology to be able to rely on the imagination at all, it had to show that it could limit fantasy and work with reason.[2] One therefore needs procedures for distinguishing the merely imagined from objects that have the possibility of actuality, or else physiology would pursue chimeras and ultimately have nothing to study and no way to study it.[3] If life were a principle, one had to make the case for its existence in order to study it and then find a method to engage with it. Yet this problem provided an opportunity. Physiology could model the cooperation of reason with imagination, which was central not only to science but also to the kind of literary criticism Coleridge sought to encourage. He therefore urged the recognition of moments of "the union of deep feeling with profound thought," which he describes in terms of "the fine balance of truth in observing *with* the imaginative faculty in modifying the objects observed" (*BL* 1:80). In this view, truth and imaginative modification go hand in hand, but the only way to achieve that was to observe with the imagination at work and to be conscious of its modifications.

Chief among methods of cooperation was hypothesis, and the key here was that the hypothesis needed to be testable either by logic or by experiment or supported by facts or laws, or else one was not seeing *with* imagination,[4] one was capitulating to it. Another strategy was to adopt something as a postulate to accomplish certain limited ends. A third option was to look for patterns that might indirectly support the existence of a principle, and one way of doing so was actively to correlate phenomena into a causal law.[5] Coleridge submits, "The progress of all great science is to labor at a law" (*PL* 360).[6] The final option was to bring the polarities of the subjective together with the objective in hopes that their correlations would enable the appearance of the absolute (Beiser, *Imperative* 76).[7] The *Biographia* tries all of these methods, and in so doing, Coleridge underscores, on the one hand, the need to at least limit imagination to objects that have the possibility of actuality so that reason can have its say. On the other hand, without the ability to see *with* imagination—to "dissolve, diffuse, dissipate, in order to recreate"—no law itself would become apparent.[8]

Understanding how physiology and imagination shape each other allows us to explain the unified ambitions of the *Biographia* in ways that criticism has been unable to do. When Coleridge referred to the *Biographia* as his "immethodical . . . miscellany" (*BL* 1:88), he alludes to the reasons why it is so difficult to find methods to reconcile imagination and reason. Coleridge agreed with Kant's thought that "genius is the medium through which Nature gives rules to art, but not to science" (Class 153) and that "genius cannot itself describe or indicate scientifically how it brings its products into being" (Kant, *CJ* 5: 308).[9] But these meant that science and art and genius are not reconcilable, which was an obstacle

to Coleridge's claims of genius.[10] Coleridge's solution in his *Biographia* was therefore to claim genius and science by insisting upon the ways in which life and imagination resisted both rules and conscious knowledge about their principles. Yet principles could be studied indirectly by paying attention to relevant patterns, which would allow one to hypothesize natural laws out of what otherwise might remain merely empirical differences or isolated facts. For Coleridge, physiology was about the drive to individuation, and he thus turns to biography, or life writing, and autobiography to find those patterns that narrate his own individuality, which can be known only retroactively. In this way, physiology helps Coleridge to counter the problem of the unknown origin, by seeing it as a retroactive posit that can be deduced. Because such individuation is beholden to the context that allows the self to appear to itself, but only in relation to an other that cannot be subsumed by the self, the imagination does not devolve into solipsism or endless regression to an unfounded origin.

My procedure here will be first to set up some contexts for Romantic physiology that help us to understand why Coleridge would and could invest himself so much in it. As he sought cures for his opium addiction, physiology increasingly became important to him.[11] I then show how the problem of vitalism—how to make present something that might be a principle—demanded models for the cooperation of imagination and reason, and one needed methods to assess how well each model worked. Kant thought that physiological science had to stick to mechanism, or else it would risk venturing beyond what science and reason could know.[12] Nonetheless, with regard to living organized matter, he turned to a concept of purposiveness because the "inner possibility of the product is understandable only through a causality in terms of purposes" (*CJ* 413), and "in terms of" reminds us that Kant is analogizing causality as if it were a purpose and thus making it regulative, not constitutive. Nonetheless, Coleridge thought that mechanism implied the death of free will, and, without free will, he could not imagine morality.[13] Where Kant turned to purposiveness via analogy, Coleridge turns to organicism and life, and tries to make life and will a part of scientific knowledge by showing his readers how to look for indirect evidence of it that would confirm it as a kind of causal law. Otherwise, imagination, will, and life would be too unruly, untameable by reason. Although Jerome Christensen reads the *Biographia* in terms of a failure "to establish the free will either ontologically or epistemologically" (96), Coleridge knows with the help of physiological science that all he can do is to posit a will, which he does so he can have a moral system, and this view endows the imagination with possibility rather presumes failure.[14] Possibility of course entails skepticism. He then argues for indirect evidence that would support

its existence so that the will is more than mere imagination.[15] An added bonus: the discipline of imagination could indicate the strength of the will.

Cooperation between imagination and reason could not take place without a healthy imagination, and thus one needed to know what its and the system's proper functioning looked like. Lorraine Daston traces how Enlightenment thinkers worried about the imagination's ability to overtake the will and pathologized a domineering imagination ("Fear" 79).[16] The fact that Coleridge recognizes how the imagination works surreptitiously to unify phenomena meant that one needed to make sure any unities did not violate reason.[17] That the imagination sometimes worked automatically outside of the will did not help. He listed "Blush[ing], contagious Yawning, Night-Mair[s], and Palpitation[s] of the heart" from fear as examples of the mind's ability to produce changes in his body without any intentional act of the will (*SWF* 2: 913). Indeed, he explicitly confronts the "surreptitious act of the imagination, which, instinctively and without our noticing the same, not only fills out the intervening spaces, and contemplates the cycle . . . as a continuous circle giving to all collectively the unity of their common orbit; but likewise supplies by a sort of *sub intelligitur* the one central power, which renders the movement harmonious and cyclical" (*BL* 1: 267). The imagination's ability to function outside of human awareness did not have to be a problem if one posited a larger intelligence at work—the Latin refers to an under-intelligence or a secondary intelligence—but this is to move beyond the claims of science. Coleridge defines intelligence as "a self-development" (1: 286). While the appearance of unity is the work of the synthetic imagination, its automaticity enables the feeling of harmony, here described in terms of "movement," which Kant had insisted made matter empirically available to us. Crucially, Coleridge limits his claims by insisting that the imagination "supplies" the harmony. He further underscores that he "assumes" the power of intelligence "as my principle, in order to deduce from it a faculty, the generation, agency, and application" (1: 286). By highlighting the figure of the circle, a symbol of infinity, and its work of "rendering," the poet underscores the work of representation.

Coleridge elaborates. In spite of the appearance of chaos, he posits a "method of Nature, which thus stores the mind with all the materials for after use, promiscuously indeed, and as it might seem without purpose, while she supplies a gay and motley chaos of facts, and forms, and thousandfold experiences, the origin of which lies beyond memory, traceless as life itself and finally passing into a part of our life more rapidly than would have been compatible with distinct consciousness and with a security beyond the power of choice!" (*Logic* 8). Several points must be made here. First, Coleridge insists nature's seeming promiscuity is an

appearance that should not prevent us from positing methods or purpose behind it and then finding kinds of evidence that would support such purpose. Second, the facts that origins are beyond our awareness and that the velocity of thought makes it impossible to have complete awareness in the moment obviate neither subsequent reflection nor the possibility of a larger organicism that would proffer intelligibility. This means that the imagination's automaticity and quickness need not vitiate its ability to work with reason and gives even more incentives to think in terms of forms and appearances so that its products can be evaluated. And, third, mental rapidity mirrors the elusiveness of life, which not only means that the one might usefully analogize the other, but also that the feeling of vitality might indicate some underlying possible unity in the form of laws between reason and imagination. The analogy functions here not as ideology but rather as a reminder of the correlations between natural phenomena and human experience that suggest the two might have something to say to each other.[18]

Saumarez helps Coleridge develop some ground rules for this cooperation, and he does so by offering repeated examples of arguments that are "unreasonable to imagine" (*New System* 2: 170). Linnaeus, for instance, falsely "imagined" that plants possess "sexual organs" (1: 300). Brunonianism, in particular, was the enemy since it rendered "life [as] an effect instead of a cause" (1: 70). He also rejects Erasmus Darwin on the grounds that he cannot understand his system because Darwin's imagination is too brilliant: "I am ready to confess that the brilliancy of Dr. Darwin's imagination is too great for the dullness of my conception" (2: 90). Brilliancy is at odds with intelligibility, and Saumarez believes that the imagination should strive for the simplicity of clarity. At one point he warns, "Imagination, assuming the office of reason, would willingly assign a particular use to every part; and pronounce one to be a residence or rather the instrument of memory, another of abstraction, a third of volition" (1: 159). Of course, particular use or localization turns attention away from the system as a whole, thus violating both reason and will. To this end, Saumarez claims that "none have [*sic*] ventured to collect and connect the [isolated facts] together—or to trace the dependence and relation that subsist between the different organs by which the whole system is constituted" (*New System* 1: v). By foregrounding relationality over difference within physiology, Saumarez highlights a need to look for and underscore cooperation. Reason thus should not rest with isolated facts but, with the imagination's help, enable the seeing of relationality.

With Saumarez's help, Coleridge sought to make the speculative powers of imagination a key player in this physiology, but to give these speculative powers

free reign, as when every part of the brain is assigned a particular use (phrenology), would amount to usurping reason. On the one hand, Saumarez declared as his goal the exploration of "the final cause of animated existence attained throughout the universe" (*New System* 1: viii). On the other hand, he recognized that "I have extended the power of life beyond what has been hitherto supposed, and that some will fancy it to be visionary and absurd. I shall however be ready to support my opinions whenever called upon" (ibid.). If "visionary" declares awareness of a necessary limit to the physiological imagination and that "final causes" belong to God, Saumarez's bracketing of his remarks as "opinions" needing support testifies to his recognition of that limit. Saumarez further insists on the constant examination of "the structure and . . . action of different animated beings from the most simple to the most complicated, . . . so that I have found the study of the subject always connected with the practice of it" (1: viii).[19]

Coleridge likewise underscores the speculativeness of his physiological claims because understanding the difference between what is known and what has yet to be proven was a key requirement for imagination to be able to work with reason, and labels his thoughts having to do with religion as "opinions."[20] Thus, in his *Hints Towards the Formation of a More Comprehensive Theory of Life* (*TOL*), Coleridge insists, "I shall have done all that I dared propose to myself, or that can be justly demanded of me by others, if I have succeeded in conveying a sufficiently clear, though indistinct and inadequate notion, so as of its many results to render intelligible that one which I am to apply to my particular subject, not as a truth already demonstrated, but as an hypothesis, which pretends to no higher merit than that of explaining the particular class of phenomena to which it is applied" (49). By framing his remarks on life in terms of an hypothesis, and not as a truth already demonstrated, he deliberately refuses to credit his claim as ontological, instead adopting the goal of explanation or intelligibility of a limited class of phenomena, which presumably would change if the facts on the ground changed. And yet there must be a correlation to phenomena if the law is to have any explanatory value. If he were a partisan of speculation, he also was careful to discipline that speculation by both probability and external objects, even though he admitted that "I have no hesitation in avowing, that many an argument derived from the nature of Man, nay, that many a strong tho' only speculative probability, pierces deeper, pushes more home, and clings more pressingly to my Mind than the whole sum of merely external evidence" (*CL* 25 May 1820, 5: 1235).[21] Here, feeling is the ground of believing, but it is, by implication, only a form of probable internal evidence.

CONTEXTS OF ROMANTIC PHYSIOLOGY

My claim that Coleridge's thinking about the imagination was heavily indebted to Saumarez and physiology is surprising on a number of counts, many of which have to do with the fact that physiology granted an important role to the imagination, and thus physiological science was hardly necessarily opposed to the creative arts.[22] Saumarez in fact thought that physiology was then more of an art than a science because it, like medicine, relied upon experience and practice and it was only just moving toward an understanding of principles and causes (*Principles* 1: 12–14). In light of Saumarez's distinction between art as practice and science as principles, Coleridge should be seen as aligning literary criticism with principles insofar as he both seeks to remove it from the concerns of merely personal interest (*BL* 1: 43–44) and thus to avail himself of knowledge gleaned from physiological science.

There are several reasons for physiology's salience. For one, we have lost sight of how capacious physiology was: historian of medicine W. F. Bynum argues that from the seventeenth to the nineteenth century, virtually all scientists believed that "the theological soul has physiological functions" (459), and thus spirit and matter had to be reconciled somehow. Physiology grew out of natural philosophy, and natural philosophy centered on finding final causes, which led back to God. Consequently, "adaptations were accepted virtually a priori as the result of design" (445). Moreover, physiologists like Cabanis, Bichat, Magendie, and Whytt reduced mental activity to sensibility, making psychology the province of physiology (Temkin, "Materialism" 318–25). We therefore have blinded ourselves to how much physiologists took for granted the imagination as part of how the mind and body work.[23] Cuvier, for instance, wondered how the imagination reproduced ideas, and he insisted that "physiology . . . shews us that there is a certain order of corporeal motions which correspond exactly to those sensations and combination of ideas" (2: 115).

Physiology thus comprehends epistemology, and the question was, how could the imagination become a reliable engine of epistemology? Physiologists felt so entitled to talk about the mind that Maine de Birain was prompted in 1808 to secure the rights of psychology over physiology, and this meant that epistemology and physiology would go their separate ways (Clarke and Jacyna 273). Indeed, Coleridge hoped to move medicine and physiology beyond mere diagnosis of symptoms and organs; he urged the inclusion of mental perceptions as well (P. Edwards 153). John Thelwall, radical, friend, and sparring partner of Coleridge, insisted that "physiological analysis of rhythmus and euphony" was essential to one's appreciation of poetry (9). Making the case for a science of elocution, Thelwall

resorted to "impress[ing] the rude imaginations" of his patients, so that they would pay attention and change their habits (13).[24] One thus needed principles to anchor the effective cooperation of imagination and reason.

Coleridge's understanding of what counts as a physiological definition, moreover, demands a place for imagination and for reason and imagination together to become suitable cognitive powers for the understanding of nature (R. Richards, *Conception* 68). Coleridge argued that "physiological definition" "must consist in the law of the thing, or in such an idea of it, as being admitted, all the properties and functions are admitted by implication" (*TOL* 25). In this view, the law must provide causal insight into the various phenomena, and thus imagination must not only draw comparisons but also abstract and harmonize those differences into a causal law. Saumarez had designated the "perfection of mind" as the "final cause of human existence" (*New System* 1: 198), thus making the imagination key to such development. He also insisted, "Knowledge, properly so called, does not simply consist in the impressions made on the senses by the operations of external phenomena; . . . he alone can be denominated the man of science, who is able to connect the cause with the effect" (*Principles* 12). Coleridge found this suggestive and went a step further by insisting that the goal of physiology was individuation, which put a concept of a will at the center of his physiology and which allowed his autobiography to dovetail with the demands of physiological understanding. In his Egerton Manuscript entry "Physiology," Coleridge defined it as being "distinguished from Physics by Life" and then further refined his definition of it as the "tendency to individualize" (folio 91). When he defines "essence" in terms of the "principle of individuation, the inmost principle of the possibility, of any thing as that particular thing" (*BL* 2: 62), he allows for the becoming of being, for its potentiality, and potentiality too must be imagined. Key to Coleridge's understanding of individualization were intellect and free will, those posited entities beyond mechanism, and this meant that his physiology actively resisted anything that might make the mind into a form of passivity and that might foreclose the potentiality offered by the will. As he put it to Thomas Poole, "If it [the mind] indeed be made in God's image . . . , any system built on the passiveness of the mind must be false, as a system" (*CL* 2:388). His "if" reminds us that God's image is a posit.

In addition, the stakes of the imagination were so high within the physiology of the time because before 1800 physiology was more of a theoretical discipline with experiment playing a subordinate role, which meant that imaginative speculation had no one necessary counter to it.[25] As Cunningham puts it, physiology's "claims to be a science were based precisely on the fact that it dealt in reasoning, not in empirical phenomena, and that it sought causes" ("Pen" 645). It was hence

simultaneously dependent upon rational speculation (637–39).[26] John Abernethy, for instance, defends theory by insinuating that what many call theory is really a product of a "lawless imagination." He elaborates, "The antipathy which some have entertained to the term theory has arisen from its misapplication . . . opinions formed by processes of mind, similar to those which occur in dreaming, when lawless imagination produced combinations and associations without any reference to realities" (*Enquiry* 8). Here, Abernethy implies that the encounter between theory and reality enables knowledge and prevents misapplication.[27]

These already high stakes were further raised by the fact that the imagination was thought to have a central physiological role in the cure of diseases.[28] Far from being immaterial, the imagination was increasingly theorized and documented to effect corporeal change. Simply put, Romantic physiology enabled imagination to matter by granting it corporeal effects. At Thomas Beddoes's Pneumatic Institute, Coleridge and Davy had given a man claiming to be ill a thermometer to put in his mouth, and the patient became convinced that he was cured by it. Davy asked him to return, and the treatment was repeated for a fortnight (Levere, *Poetry Realized* 20–21). While the famous Albrecht von Haller fingered the imagination for the pregnant mother's cravings (*Dissertation* 330), the noted physiologist John Hunter credited it for both nocturnal emissions and impotence (*VD* 198–99), and the physician James Adair claimed it was responsible for hypochondria. Hunter cautioned men feeling impotent that "the imagination will operate so strongly as to make the patients believe they really are weakened" (199). Indeed, the American physician Benjamin Rush defined as facts "the influence of the imagination and will upon diseases" and lectured physicians to "avail [them]selves of the handle which these powers of the mind present us in diseases" (6).

Anton Mesmer and Benjamin Perkins helped to document the influence of imagination within physiology and thus helped to make a "rational physiology" seem more realizable in at least two ways.[29] Mesmer claimed that he could manipulate "animal magnetism" and cure patients of various ailments. Physicians in France were so concerned by Mesmer's infiltration into French medicine that they got King Louis XVI to convene a panel to examine whether Mesmer had these powers or whether he was a charlatan. Benjamin Franklin was one of the examiners. They concluded that "animal magnetism" was mere imagination, and Mesmer's influence could be explained by the impressionable imaginations of his often female and lower-class patients. Yet if the commissioners disproved mesmerism, they raised the fortunes of imagination and documented that the imagination mattered. They blindfolded themselves and the patients, and, since no one knew when they had received a treatment, one could ferret out whether the alleged

cure actually worked. The imagination then precipitated both the double-blind experiment and the use of placebos, and in so doing helped to make the discipline more rational, insofar as it had improved how it could test claims. In the mid- to late eighteenth century, Elisha Perkins sold metal tractors at an astonishing five guineas per set, which he claimed could cure patients of everything from insect stings to epilepsy. He counted none other than George Washington as one of his patients (Langworthy 39). Perkins had learned a thing or two from Mesmer's downfall, and so he sold these tractors at a high enough price so that the lower classes and their feeble imaginations would not be an issue. The physician John Haygarth decided to test whether these rods had any powers at all, and so he painted wood versions of these metal tractors and found his patients reported them to be equally efficacious. He encouraged others to test the tractors and advised them that "the cases should be accurately stated, and the reports of the effects produced by the true and false tractors be fully given, in the words of the patients" (4: 2). Since wood lacked the properties to do the work, the only explanation was that those patients had been cured by their imaginations. Haygarth concluded one of his reports with, "This astonishing power of the Imagination was evinced by the unanimous testimony of four physicians and fifteen surgeons and philosophical spectators" (4: 38). If Romantic science helped validate the imagination's curative powers, it simultaneously put such techniques as the placebo and the double-blind experiment in place. Coleridge himself wondered why there was so much hostility toward animal magnetism, and he resolved "to see it <tried> by others . . . and till then [remain] neutral" (*SWF* 1: 595). That is, he wished to subject it to scientific scrutiny. These newly documented imaginative powers, then, were to be contained by insisting that only women and the poor believed in them, granting them efficacy.

SPECULATION AND HYPOTHESIS

A physiological understanding of the imagination allows us to see how interconnected the fortunes of the imagination, theory, and hypothesis became during the Romantic period. The role of imagination within physiology enables us to put to bed the notion that the Romantics were, as friends of the imagination, hostile to science. Because within physiology hypothesis could be regulated by being brought in line by either a scientific experience (a statement about the world known to be true thanks to the senses [Dear, *Discipline* 12–13]), or by experiment, or by what William Whewell would name consilience, or by epistemological modesty, all of which were enhanced by a disciplined subjectivity that would come to be objectivity (Daston and Galison), the imagination's ability to foster delusion

and fantasy could likewise be constrained by careful discipline.[30] Once the imagination is disciplined, the very power to visualize something not present or visible can become valuable, since one must imagine how to operationalize experiment and share both the experience of the experiment along with any concomitant doubts.[31] The tendency of historicist critics to equate the imagination with ideology thus ignores the methods of discipline the culture put into place to prevent that very problem.

Physiology's disciplinary issues became ensnared with the problems of imagination because the ability to posit things not present is aligned with hypothesis, theory, and speculation. Physiology provides ways of imagining the contact zones between reason and imagination, mind and body, not to mention science and religion. Saumarez seeks to make physiology into a coherent system, and Coleridge follows suit by asking about the imagination's role in the development of both mind and faith. And, in fact, Coleridge underscores how, when disease renders a patient unintelligible to him- or herself, he or she becomes "more distressed in mind, more wretched, from the fact of being unintelligible to himself and others, than from the pain or danger of the disease" (*BL* 2: 234). Making the individual intelligible to him- or herself was thus part of the aim of physiology, and one might say that autobiography thus became a physiological genre.

Paul Ricoeur argues that "every science has a right to allow conjecture to run ahead of confirmation for a time" (118), and, without conjecture, physiology would have no path forward. In the absence of cell theory, electrophysiology,[32] and brain scans, could one have knowledge about the imagination and the brain?[33] If one wanted to talk about the brain at all, therefore, one could not conveniently demonize speculation/hypotheses/imagination. Even Newton himself could not resist hypotheses in his Queries: historians of science therefore recognize two Newtons, the one of the *Principia* and the other of the *Optics*. One has to imagine a thing to prove it true. The fate of imagination and hypothesis within science depended in part on whether one thought speculation might help, by positing purposiveness in nature while recognizing that one had no basis for positing godly design, or make things worse, by generating occult entities about which science had nothing to offer. When materialism was equated to French atheism, speculation might rescue the scientist from becoming a scourge. Scientists, of course, generally could not afford then to look like atheists, and, in *Science and Spirituality*, David Knight has insisted that scientific thought up until the early nineteenth century was often of a piece with religion.[34] And Coleridge considered that too much reliance upon rationalism would allow the soul [to] become "a mere *ens logicum*" (*BL* 1: 117), and for that reason both the feltness of its spontaneous

intuitions and information from the senses mattered.[35] Today, Stephen Asma argues that the "imagination is a multi-media processor that jumps laterally through connotations, rather than downward through logical inferences" (27), and Romantic thinkers acknowledge something like this when they turn to association to explain how it works, and then render association into a law so that one did not have to specify its workings beyond spontaneity.

The problem, then, was not how to get rid of imaginative speculation but rather to work with it and figure out its limits, which entailed getting the imagination to work with reason instead of against it.[36] Pretending something is true can be productive for science. And pretending that something is true for a larger gain, like the possibility of morality, was a risk Romantic scientists were sometimes willing to take.[37] Charles Henry Wilkinson speculates in his *Essays Physiological* that there "may be an insect to whom a mite is an elephant: we may even carry our imagination so far, as to suppose, with Malebranche . . . that in a spot our visual powers are not capable of discriminating, a world may be contained" (188–89). Although Bacon was famous for his advocacy of experiment and was considered to have a "habitual aversion to all speculation," Coleridge insisted to the contrary that "those sciences ought not to be thought useless that are in themselves useless, if they sharpen and order the wits" (*BL* 1: 290).[38] But how then to know when speculation sharpened the wits or had gone too far? Kant had argued that the imagination should not encourage occult qualities, and Coleridge likewise rejects material explanations supported only "by the imagination" (*TOL* 29), which, in the name of substance, often multiplied occult entities, making claims of ontology hardly the work of essence.

Those limits were difficult to suss out, especially because "experiment" had limited powers against speculation.[39] Saumarez explains that physiological experiment was sometimes the brutal work of one's hands, and as such was powerless against excess speculation: "There is not a lad of twenty years of age, who comes from the country to any of our hospitals in town, and who, after passing with common industry two seasons in any of our anatomical schools, is not perfectly competent to perform any physiological experiment. In addition to a precise knowledge of position, the only requisites wanting, are a steady hand,—a sharp knife,—a tolerably good pair of eyes, and an unfeeling heart" (*Principles* 7). He argues that "science begins from principles, and proceeds through proper media to the conclusion, from cause to effect, from things general and universal to things particular and occasional" (*New System* 1: 190). Without principles, experiment was blind. John Abernethy agreed, insisting that "experimental science has not as yet informed us of more than reason has suggested" (*Enquiry* 34–35),

and he argued that "hypothesis and theory are the natural and inevitable result of thinking" (8).

By starting with principles, Saumarez was trying to shore up the intellectual prestige of physiology: even the brilliant physiologist John Hunter was known as the knife man or a butcher. Borrowing from Saumarez, Coleridge insists upon "the laws explained by which experiment could be dignified into experience" (*TOL* 30).[40] A later entry in *Table Talk* fleshes out Coleridge's ambivalence to experiment: "Personal experiment is wanted to correct Observation of those experiments which Nature makes for us—i.e. the phenomena of the Universe; but Observation is more wanted to direct and substantiate the course of Experiment. Experiments of themselves cannot advance Knowledge; they amuse for a time and then pass off the scene and leave no trace behind them" (1: 212). Here Coleridge claims observation is "more wanted" than experiment, but also note the modifier "personal," which seems strange.[41] Personal experiment counters nature's experiments, which human beings can only know as phenomenality. Not only does "experiment" move from the subject to the object and back again to the perceiving subject, but "observation" must entail reflection, and therefore involve both the poles of subject and object. However, instinctive intuition offered some kind of footing. He argues, "The necessary tendence therefore of all natural philosophy is from nature to intelligence; and this, and no other, is the ground and occasion of the instinctive striving to introduce theory into our views of natural phaenomena" (*BL* 1: 256). In this view, our instinctive theoretical striving provides both logical evidence for final causes and enables intuition, but logical evidence and intuitions were not to be confused with empirical evidence. Natural philosophy, moreover, tells us something about how our minds work. That instinctive striving was also important because it tied thought to the spontaneity of being, which allowed rules to emerge from the process of thought and thus enabled reason to move beyond the mechanical application of preexisting ideas and rules and toward free will.[42]

Saumarez further helps Coleridge to hypothesize the laws of action behind life and to focus not on the parts themselves but rather on the entire system. Saumarez notes that the "infinite multitude of animated beings we behold in the universe, the various faculties and powers they possess, prove that each system, not only in its progress and evolution, but in the various operations it performs, is governed by laws distinct and peculiar, dependent on the class to which it belongs; and that the living matter of which it is composed is totally different from common matter in a common state" (*New System* 1: 3–4). Here he posits different laws for living matter as a whole as well as for its local classes, and the question is

how to get to them. When Saumarez labels the "perfection of mind" as the "final cause of any rational physiology" (1: 198), he provides a potential basis for the finding of those laws, though "final causes" does venture into metaphysics.

Coleridge does feel a strong pull to the speculative side of things, as did Saumarez and much physiology writ large. It is especially telling that he risks an alliance with the mystic Jacob Behmen, a theosophist about whom Coleridge remarks, "Many indeed, and gross were his delusions" (*BL* 1: 146–47). He adds, "There appears to have existed a sort of secret and tacit compact among the learned, not to pass beyond a certain limit in speculative science" (1: 148). He continues, "The true depth of science, and the penetration to the inmost centre, from which all the lines of knowledge diverge to their ever distant circumference, was abandoned to the illiterate" (1: 148). Yet to value speculation was not necessarily engaging in "lawless speculation," not to mention that a limit to speculation in advance of it was no less dogmatic. Coleridge further takes up from Kant the need to figure out what this entails (1: 237), by which Coleridge means, as Kant did, airy speculations like corpuscularism or those that exceed the possibility of our experience and therefore threaten the very possibility of a "rational physiology" (1: 132). In his *Theory of Life*, Coleridge insists that the definition of life "must consist . . . in the law of the thing, or in such an idea of it, as, being admitted, all the properties and functions are admitted by implication" (25). Because the particulars must speak to a larger general law, he "reject[s] fluids and ethers of all kinds, magnetical, electrical, and universal," because they are "super-substantiated" (34) and are therefore ironically beyond substance, and be on alert to avoid such "notional phantoms" (*BL* 1: 244). By this, Coleridge means notions that either defy laws of embodiment or that exceed our ability to have some experience of them. Both instances show his awareness that imaginative speculation can be unproductive.

Yet to value Behmen's speculations in spite of their failures and offer what amounts to a historical corrective to that compact against them, Coleridge draws a distinction between enthusiasm and fanaticism, even insisting with rhetorical flourish that the distinction is a "contradistinguish[ing]" (*BL* 1: 147). While Coleridge likens the latter to a swarm of bees, "whose wild and exorbitant imaginations had actually engendered only extravagant and grotesque phantasms" (1: 149), the former amounts to "the perception of a new and vital TRUTH tak[ing] possession of an uneducated man of genius." Coleridge elaborates, "Need we then be surprised, that under an excitement at once so strong and unusual, the man's body should sympathize with the struggles of his mind; or that he should at times be so far deluded, as to mistake the tumultuous sensations of his nerves, and the co-existing spectres of his fancy, as parts or symbols of truths which were opening up on

him?" (1: 150–51). The upshot here is that, whereas fanaticism does not even have the possibility of getting to the truth, enthusiasm can amount to a perception of a truth, but Behmen's mistake is to be possessed by the truth rather than being capable of evaluating it. Behmen once again allows Coleridge to assert a difference between seeing with the imagination and being captivated by it. Coleridge's explanation stresses the power of ideas to affect the body, but we should also note how the correlation of "tumultuous sensations of his nerves" with "spectres of his fancy" is not a relationship of identity but rather one of mistaken interpretation. Interpretation and the understanding of the limits of correlation, then, provide possible ways to make the will the driver of physiology. And even Behmen could help Coleridge figure out what genuine cooperation between reason and imagination looks like, and, to this end, one needed at very least methods that would distinguish between phantasms and truth.

In the physiology of the time, thus, we find on the one hand a need to speculate in order to make steps forward and have intelligibility. On the other hand, we find a modesty that asserts itself to limit anything smacking of metaphysics so as not to generate phantasms. Dr. Haighton's thirty lectures in physiology is exemplary. Haighton insists, "We do not pretend to explain to you the manner in which the brain performs its office. We only know that it imparts a something to the nerves by which sensation and volition are carried on; we also know that these can perform no function without the assistance of the brain" (184). Nonetheless, he felt the need to end with this: "conjecture with a great degree of probability. Nerves are conductors of electrical fluid. The experiments made by Galvani and which are resolvable into one, tend to render the theory that the nerves convey a something analogous at least to the analogous to the electric fluid very probable" (203–04). Haighton's modesty is typical: he does not let us forget that these remarks are at best "probable," and he urges that the relationship between nerves and electricity is nonetheless merely analogical. Here the literariness of the figure enables intelligibility yet imposes a modesty upon science. That is to say, figurative language was useful to science.

The diminished role of hypothesis within Romantic science further complicates what a rational physiology might look like. In the mid-eighteenth century, Franklin, Buffon, Hartley, and Boscovich hypothesized unobservable entities to explain observable ones: fluid electricity, organic molecules, vibratiuncles, and points (Laudan 12).[43] These led to a methodological impasse: How could induction and experiment justify these entities? Such an impasse helps explain why between 1720 and 1830, hypotheses had fallen radically out of favor within science (Laudan 10–12). No friend to hypothesis, Thomas Reid wrote a compelling polemic against

them, arguing that no real discoveries in physiology and anatomy were ever made by them (*Essays* 1: 49). His choice of physiology as the ground for thinking about the uses of hypothesis was no accident: after all, everyone had a stake in thinking about how the body and mind cooperate to deal with both sensation and thought (Jackson, *Science and Sensation*). Moreover, since "conjectures and hypotheses are the invention and workmanship of men, . . . [they] will always be very unlike to the works of God, which it is the business of philosophy to discover" (Reid 1: 48). Unlike Kant, who thought hypothesis and imagination could be disciplined by reason, Reid lambasted hypothesis as prideful and useless and, even worse, a hubristic challenge to God's works.[44] According to Reid, not a single law or discovery was the result of speculation about nature. He then quotes Newton's distrust of hypotheses, making him a key ally for cordoning off science from hypothesis (1: 51–52). But of course this was merely selective quotation. Lorraine Daston and Peter Galison frame the issue surrounding hypotheses this way: "how to know when a hypothesis was not a beacon but a fata morgana?" (313). "Fata morgana" raises the issue of an undisciplined imagination, which is why reason and imagination were so insistently yoked together in the science of the time.

A close examination of Thomas Reid's dismissal of hypothesis shows his assumed linkage of hypothesis and imagination to their mutual detriment.[45] Reid submits, "Conjectures in philosophical matters have commonly got the name of hypothesis, or theories. And the invention of hypothesis, founded on some slight probabilities, which accounts for many appearances of nature, has been considered as the highest attainment of a philosopher. If the hypothesis hangs well together, is embellished by a lively imagination, and serves to account for common appearances; it is considered by many as having all the qualities that should recommend it to our belief" (*Essays* 1: 47). Reid refutes the many, insisting that our beliefs should have higher criteria. In thinking about why hypotheses had recently gathered enough steam to be dangerous within science, Reid points to the role of intelligibility within natural history, a goal that makes accounting for appearances, in his view, wrongly more important than truth. Even worse, because "men of genius" are especially "prone to invent hypotheses" (1: 47), the fortunes of hypotheses rise with the cult of Romantic genius. Implicitly, Reid suggests that such genius amounts to an overestimation of human powers. Finally, he claims that "discoveries [in physiology] have always been made by patient observation, by accurate experiments, or by conclusions drawn by strict reasoning from observations and experiments; and such discoveries have always tended to refute, but not to confirm, the theories and hypotheses which ingenious men had invented" (1: 49).[46] Perhaps because it is so difficult to come up with a protocol for inventing

useful hypotheses, not to mention to discipline geniuses, Reid would not admit that hypotheses provide things to confirm. Note how Reid lines up on one side patience, strictness, and accuracy against ingeniousness and invention. Kant had rejected genius within science because there was no rational accounting for it: "It cannot itself describe or indicate scientifically how it brings it products into being" (*CJ* 308). Because it was so difficult to invent rules for inventing hypotheses, the resistance of hypothesis to method made it dangerously close to genius.[47] Yet even Reid recognized that "in the operations of mind . . . we must often be satisfied with knowing that certain things are connected and invariably follow one another, without being able to discover the chain that goes between them. Such conventions are what we call 'laws of nature'" (203). Laws, then, finesse the gap between particulars and knowing.

Some Romantic physiologists followed Reid and argued for the need to simply jettison hypothesis because it was equivalent to a prejudiced notion. In his *Academical Lectures on the Theory of Physic*, Herman Boerhaave consistently linked the term "hypothesis" to a prejudiced notion, and the great Albrecht von Haller treated "hypothesis" with skepticism, going so far as to insist, "beyond the scalpel or microscope I do not make many conjectures" (cited in Gigante 17). John Haighton laments the fact that physiology itself had been reduced to the hypothetical: he argues, "Many have deprecated the study of physiology as being merely hypothetical and therefore of no real use; but such as do this, do this as an excuse for their idleness or to bring others down to a level with their own contracted understanding" ("Physiological Lectures"). Georges Cuvier thought it necessary to distinguish between metaphysical and physiological hypotheses: "By what means is our imagination able to reproduce [images], and our judgment to combine them, draw conclusions, and form abstractions from them? These and other effects of habit and attention, the metaphysician may establish historically, but the physiologist cannot explain" (1: 115).

Coleridge, by contrast, strives to make hypothesis more useful and even methodologically coherent, recognizing that, even if one could not generate protocols for its invention, one could develop ways of testing it so that hypothesis could yield probability. When theories could not be proven or disproven or at least made more probable, they were not scientifically useful as hypotheses.[48] Hence, in the *Biographia*, Coleridge praises Aristotle for proffering "a just theory without pretending to an hypothesis" (1: 101). Although the Greek philosopher uses "movements" to express representations, "he carefully distinguishes them from material motion" (1: 102). Unlike many physiologists who offer such imaginary entities as "successive particles propagating motion like billiard balls . . . or animal spirits . . . or

chemical compositions by elective affinity" (1: 101) in the name of material objects, Aristotle knows the difference between theories and hypotheses, images and things. Theories were fine so long as they did not pretend to be making ontological claims.

We witness Coleridge elaborating on how imagination should cooperate with reason in his discussion of hylozoism and the proper use of hypothesis. Hylozoism was the theory that all matter is part of life or being (*BL* 1: 131n4). Kant had argued, "If we are to make a hypothesis that [we acknowledge to] be very daring, we must have certainty that the basis we have assumed for it is at least possible, [so that we] can be sure that the concept of that basis has objective reality" (*CJ* 394). Note that Kant insists the *concept* have a basis in objective reality, which is a long way from the claim of the reality of hylozoism as a thing. Rather, the concept must have some correlation to phenomena. He knocks Spinoza because he thinks "the mere presentation of the unity of the substrate," referring to the conatus, "cannot give rise to the idea" (394). Coleridge agrees, and warns that hylozoism amounts to the "death of all rational physiology, and indeed of all physical science; for that requires a limitation of terms, and cannot consist with the arbitrary power of multiplying attributes by occult qualities" (*BL* 1:132). Coleridge echoes Kant's claim that hylozoism is nothing less than "the death of all Naturphilosophie" (*MFNS* III, 544). The problem with "occult qualities" is that they impose no limits on science and do not even impose Kant's demand of the possibility of actuality. Without those limits, the imagination runs amuck.

David Hartley, one of the strongest supporters of hypothesis, argued, "The frequent making of Hypotheses, and arguing from them synthetically, according to the several Variations and Combinations of which they are capable, would suggest numerous Phaenomena, that otherwise escape notice, and lead to Experimenta Crucis, not only in respect of the Hypothesis under consideration, but of many others. The variations and Combinations just mentioned suggest Things to the Invention, which the Imagination unassisted is far unequal to" (1: 347). Hartley insists that hypothesis must lead to experiments, and he even lends support to the myth of the crucial experiment that will solve all the problems; moreover, he calls upon the imagination as a part of the invention of variations and combinations, though he warns that the unassisted imagination cannot cope with all those variations.

We are now prepared to look more closely at Coleridge's rejection of Hartley and to see how hypothesis plays a role in that rejection, along with the implications of this for the imagination. Although Coleridge appreciates Hartley's support of hypothesis, Hartley's method of hypothesis was fatally flawed. From Coleridge's perspective, Hartley's problem is that his system is not even logically tenable: his

suppositions are so incoherent that they merit the name of "suffictions," since one hypothesis is used to buttress another hypothesis, and no facts or observations are involved to back them up. Kant had warned that "if something is to serve as a hypothesis to explain how a given phenomenon is possible, then at least the possibility of this something must be completely certain" (*CJ* 466). The certainty of possibility becomes the benchmark for measuring the imagination's contribution. "Suffictions" thus reminds readers of the need for standards of evidence, since there is only thin air holding the hypothesis up, leaving no possibility of testability of the claims. Accordingly, Coleridge lumps Hartley together with "more recent dreamers . . . of chemical compositions by elective affinity, or of an electric light at once the immediate object and the ultimate organ of inward vision" (*BL* 1: 101).[49]

Crucial to the project of cooperation between reason and imagination was a keen understanding of what an image actually means. Saumarez had warned that "the elastic force of human imagery" was responsible for the false assumption that the medulla of plants was analogous to brain and nerves of animals: plants, Saumarez insists, were not endowed with sensibility (*New System* 1:312). Coleridge thus warns that although metaphysical systems become popular "in proportion as they attribute to causes a susceptibility of being seen, if our only visual organs were sufficiently powerful" (*BL* 1: 107), one must not credit imagination or the possibility of visualizability for truth. He continues, "It is a mere delusion of the fancy to conceive the pre-existence of the ideas, in any chain of association as so many differently colored billiard-balls in contact" (1: 108). Coleridge's simile, his advertised "as," seeks to remind his audience of what Hartley himself forgot, the essentially figurative status of his vibratiuncles. In a reversal of what historicist Romantic critics of the imagination suggest, he thus accuses Hartley of what we call ideology and reminds us that fancy, not imagination, lacks the capacity to recognize the difference between the real and ideal. Coleridge thus concludes that the law of Hartleyan association would amount to being "the slave of chances" (1: 116).[50] He insists, "In association then consists in the whole mechanism of the reproduction of impressions" (1: 103), tarring association with the brushes of mechanism and idolatry.

Moreover, anytime images have an agency of their own, they risk idolatry.[51] Bacon had linked the imagination to the idols of the mind, making it the subject of much distrust. Simply put, its images could become idols. Bacon thus warned in *The New Organon* that "human understanding is moved by those things most which strike and enter the mind simultaneously and suddenly, and so fill the imagination, then it feigns and supposes all other things to be somehow, though

it cannot see how, similar to those few things by which it is surrounded" (98). Framing understanding as easily moved and the imagination as an empty container needing to be filled, Bacon makes it difficult for the imagination to work with reason. Blumenbach warned that the imagination "wakes up the very images of things, bestows on them form and colouring, and marshals them under the view of the mind, as if the objects themselves were again actually present" (*Elements* 196–97). Hence, Coleridge cautions that picturability is not the same as intelligibility or knowledge. He mocks the presumptions that "whatever our fancy (always the ape, and too often the adulterator and counterfeit of our memory) has not made or cannot make a picture of, must be nonsense" (*BL* 2:235). Chastening "modern philosophers," he derides the assumption that "nothing is deemed a clear conception, but what is representable as a distinct image." The danger here is that "the conceivable is reduced within the bounds of the picturable" (1: 288), and the unspoken danger is that fancy will "ape" clear images.

Only an imagination that was too weak would allow itself to capitulate to the images it produced. Coleridge thus reminds readers that "a dimness of the imaginative power, and a consequent necessity of reliance upon the immediate impressions of the sense, do, as we know, render the mind liable to superstition and fanaticism" (*BL* 1: 30). In this view, imaginative weakness could lead to an overreliance upon immediate empirical sensation, and, by connecting empiricism to superstition, Coleridge pushes back on the unquestioned hierarchy between perception and ideas even as he makes perception more active. Moreover, he stipulates that the will can act "by confining and intensifying the attention . . . [to] give vividness or distinctness to any object whatsoever" (1: 127). And, to this end, he deploys the word "sensuous" to refer to "perception considered as passive, and merely recipient" (1: 172). Finally, he calls it "delusion" when one "simply permits the images presented to work by their own force" (2: 134).

What has obscured Coleridge's self-reflexiveness about Romantic images is de Man's influential reading of them. De Man, we recall, stipulated that Romantic images had a nostalgia for nature and its alleged stability, which made them especially susceptible to what he called ideology ("Intentional Structure" 13–15). Coleridge, by contrast, brackets the image and refuses to let it become nature by making it an object of epistemological inquiry. He then insists that the imagination's images are limited to possibility, thus imposing upon them skepticism. De Man's "image" is closer to Coleridge's depiction of how fancy works. In this view, the deconstructive critic is the one with the nostalgia for nature, because that nostalgia underwrites the de Manian definition of ideology: "What we call ideology is

precisely the confusion of linguistic with natural reality" (*RT* 11). To make matters worse, this alleged nostalgia screens the degree to which the discourse of Romantic nature itself resists such metaphysics.

Coleridge's thinking on how to handle the imagination's images is even more specific.[52] Using the example of a drawn line, Coleridge writes:

> Philosophy is employed on objects of the INNER SENSE, and cannot, like geometry, appropriate to every construction a correspondent outward intuition. Nevertheless philosophy, if it is to arrive at evidence, must proceed from the most original construction . . . In Philosophy the inner sense cannot have its direction determined by any outward object. To the original construction of the line, I can be compelled by a line drawn before me on the slate or on sand. The stroke thus drawn is indeed not the line itself, but only the image or picture of the line. It is not from it, that we first learn to know the line; but, on the contrary, we bring this stroke to the original line generated by the act of the imagination; otherwise we could not define it as without breadth or thickness. Still however this stroke is the sensuous image of the original or ideal line, and an efficient mean to excite every imagination to the intuition of it. (*BL* 1: 250)

Coleridge is very careful to separate inner from outer and to avoid analogizing the outer from the inner: the outward cannot direct the inner sense. Seeing with imagination, thus, requires the ability to see from both perspectives. He labels the imagined line, "the line generated by the act of the imagination," as original, giving it temporal priority over the representation of it. Coleridge here considers how the imagined idea of it enables one to abstract away the qualities of depth and breadth. By meticulously separating the inner imagined image from the outer drawn existing image, which is in turn a "sensuous image" of the imaginary line, Coleridge limits the kinds of knowledge that can be gleaned from it. "It is not from it (the sensuous stroke just drawn), that we first learn to know the line," Coleridge cautions, taking care to separate the representation both from its imagined appearance and from knowledge of the thing. What the sensuous representation can achieve is "an efficient means to excite every imagination to the intuition of it." Intuition is a feltness that is not yet scientific knowledge, though the shared nature of the excitement—the communication of it—is properly the work of imagination. Making matters more convoluted, philosophers often assume "impresses or configurations in the brain, correspondent to miniature pictures on the retina painted by rays of light from supposed originals" (1: 258). Coleridge therefore warns that "deductions from it" are only "for the purposes of explanation" (ibid.) and implicitly do not count as evidence. Note his emphasis on "correspondent." John Aber-

nethy had famously declared that "the phenomena of electricity and of life correspond" (*Enquiry* 39), and even he was careful not to presume an identity.

By reminding us of a difference between picturability and intelligibility, Coleridge demands that the imagination's pictures become essentially objects of critical reflection and not assent. So too does he insist that distinct images are not the same thing as clear conceptions (*BL* 1: 135), thereby widening the gap between image and thought. Furthermore, by framing a "coincidence of subject and object" and not an identity between the two (1: 252) as the vantage point from which to evaluate it, he creates space for the images of imagination to be representations, which, in turn, underscores their role as opportunities for reflection. Where identity imposes one meaning, coincidence and correspondence not only allow for multiple takes on this convergence of happenstance but also refuse the imposition of any one version of causality as a logical predicate.

PHYSIOLOGY OF KANT AND BLUMENBACH

Romantic physiology struggled with what to do with life, and these struggles were instructive to Coleridge because they let him know the imagination could not simply be given free reign, especially since some worried that vitalism was merely a phantom of the imagination. If imaginative speculation were to be productive for science, hypothesis had to conform to rules and dogmatism had to be eschewed. Those rules nonetheless could shift based on the larger philosophical framework in place. Although Coleridge's critics have been divided on the meaning of his use of Kant, with some arguing that it amounted to mere undigested appropriation (Wellek) and others insisting upon thoughtful use of him (Class), my interest here is to show how Kant and Blumenbach helped shape what Coleridge thought healthy cooperation between imagination and reason might look like.

One strategy was to link the rationality of physiology with the argument by design, and in this way science could reinforce theology. Kant, however, had fairly recently taken issue with what he calls "physicotheology" because he considered it to be incoherent. He argues, "No matter how far we take physicotheology, it still cannot reveal to us anything about the final purpose of creation, for it does not even reach the question about such a purpose" (*CJ* 438). For Kant, to conduct biological research, it was necessary to assume the notion of a purposive agent without presuming the existence of a designer, which would take science into theology. The way forward would be to apprehend biological organization as if it were designed—the "as if" coming from the imagination—and to presume "some original organization uses mechanism, . . . without which there can be no natural science at all" (419). So while purposiveness is necessary to account for the possi-

bility of an organism, was it also real? At the same time, since mechanism alone was "insufficient to allow us to conceive of how organized beings are possible" (422) and although purposiveness is there, one must continue to limit oneself to mechanical explanations if one is to keep to science. Coleridge disagreed.

As Kant explains, purposiveness had the capacity to "guide our investigations of organized subjects and to meditate regarding their supreme basis . . . for the sake of [assisting] that same practical power in us [viz., our reason] by analogy with which we were considering the cause of the purposiveness in organized objects" (*CJ* 376). The benefit of this strategy, Kant maintains, is that the investigation of the cause of organized subjects thereby requires the very exercise of reason (the practical power in us), and part of this exercise of reason is knowing the limits of our reason and sticking to those limits. At the same time, Coleridge is aware of the fallacy of mistaking "the process by which we arrive at the knowledge of a faculty for the faculty itself" (*BL* 1: 123). Although purposiveness in Kant is an a priori idea because it is necessary to account for the inner possibility of organized beings, it is the imagination working with reason that allows empirical evidence to be connected to that idea. Kant puts it thusly: "This apprehension of forms by the imagination could never occur if reflective judgment did not compare them, even if unintentionally at least with its ability to refer intuitions to concepts" (*CJ* 190). He also warned that mechanism had to be combined with purposiveness because "[going to the extreme of explaining everything only mechanically] must make reason fantasize and wander among the chimeras of natural powers that are quite inconceivable, just as much as a merely teleological kind of explanation that takes no account whatever of the mechanism of nature made reason rave" (411). Kant suggests that looking at living beings with mechanism by itself or purposiveness by itself would allow imagination to usurp reason, either by encouraging fantasy and chimeras or by making reason rave. Earlier, he had described the convergence of transcendental idea and its objects as only "an idea (focus imaginarius)" (*CPR* B672). For our purposes here, the status of purposiveness had tremendous implications for imagination's ability to work with reason.[53] Because Coleridge posits the imagination is a "living power," and because physiology itself is underwritten by the fact that purposiveness—which Coleridge often refers to as "intelligence"—is a concept that corresponds to empirical data but cannot dogmatically refer to a beyond beyond itself, Coleridge learns from Kant the virtues of being modest about the ontology of intelligence within science, and he applies this wisdom to his thinking about organicism.[54] Although Coleridge does argue that "a productive Idea, manifesting itself and its reality in the Product, is a Law, . . . A physical Law, in the right sense of the term, is the sufficient Cause of the

Appearances" (marginalia to Richard Hooker, *CM* 2 :1144–45), his qualifier "productive" insists that the idea must be evaluated before it can become a candidate for "manifest" reality. Crucially in this marginal note, Coleridge takes Hooker to task for asserting the preexistence "of the Thing to all its constituent powers . . . and which under any scheme of Cosmogony is a mere phantom, having its whole and sole substance in an impotent effort of the Imagination or sensuous Fancy" (*CM* 2: 1144). Kant, in turn, was following Blumenbach.

Blumenbach, Coleridge's teacher, developed the concept of the *Bildungstrieb*, a formative force. Kant praised Blumenbach for having "establish[ed] correct principles for applying it, which he did by avoiding too rash use of it" (*CJ* 424). Most physiologists of the time granted organicism some kind of causal role but took from Kant the need to justify their metaphysics (Beiser, "Kant and *Naturphilosophie*," 8–10). Blumenbach explained his reasoning in his *An Essay on Generation*. "It is to be hoped, that there is no necessity for reminding the reader, that, the expression Formative Nisus, like that of attraction, serves only to denote a power, whose constant operation is known from experience, but whose cause, like the causes of most of the qualities of matter is a *qualitas occulta* to us. We may say this, as of all similar powers, what Ovid says:—Causa latet, vis est notissima" (20–22). Blumenbach clearly defines this formative nisus as an effect, and he is careful to insist that our experience has access to it, but only as an effect. Formative nisus, thus, is here the expression of an effect. Experience shows us its constant operation but can neither get to its cause nor claim it as cause. Blumenbach even quotes Ovid to say that "while the results are known, the cause is hidden," and Ovid makes this pronouncement about the cause of Salmacis's fountain's ability to enervate men in book IV of *The Metamorphosis*. If causality is beyond knowing, then the obligation is to extrapolate general laws from the phenomena that have the potential to be the form for causality, but not causality itself.[55] Blumenbach thus appropriates Ovid's figurative language to indicate a gap between effect, which can be seen, and cause, which cannot, but the power of his concept of the nisus stems from its ability to be both cause and effect. While this gap suggests for Kant Blumenbach's awareness of the limits of the concept, Blumenbach's use of the concept is not in actuality so tidy. It is fitting that Ovid's *Metamorphosis*, which is about change but not so much about causality, provides Blumenbach with the figurative language with which to finesse this difference, but the figure is of an enervating fountain, which claims effects but not causes.

Blumenbach goes on to state, "I know no means so well calculated for rendering the existence, and activity of this nisus evident to an impartial eye, as to observe the origin and progress of such organized bodies, which increase so rapidly

in bulk, that the action of the growth becomes almost evident; and which are of delicated and semitransparent a texture as to be capable of being evidently seen thought with the assistance of a microscope, and a due degree of light" (*Essay* 62). Several points need to be made. Blumenbach must figure out how to *render* the existence of the nisus, which means that instead of taking ontology for granted, he has to make a case for it and then show us what to look at.[56] To do that he adopts the stance of an "impartial eye" and then invents kinds of evidence that would speak to that eye. He chooses the embryo's growth but warns that the semitransparent texture of the growing organs makes the action difficult to see. By defining the nisus in terms of its action, he correlates its effects, which can be seen, to its cause, which cannot. Frederick Beiser suggests one further nuance, which is that the Romantics take Kant's concept of natural purpose and then generalize it to all of nature. As a result, "there is no fundamental difference in kind between the ideal and real, the mental and physical, since they are only different degrees of organization and development of living force" ("Kant and *Naturphilosophie*," 12). I would qualify Beiser to insist that while this is true of their idealizing moments, in times of skepticism, they saw the dangers of this strategy. The Romantic imagination writ large is about this very problem. Where Kant praises Blumenbach for recognizing the difference between cause and effect, which seems to license a distinction between the regulative and constitutive use of concepts, Coleridge sees in Blumenbach a method for "rendering" imagination into reasoned cause that does not dogmatically assume a particular cause to be an empirical object.

In his manuscript on physiology, Coleridge adopts Blumenbach's idea of a formative nisus. In it, he tries to solve the problem of how to get to an I or consciousness that is distinct from the organic body but yet of a piece with it. Here is how is goes about it:

> There is but one way of escaping—namely beginning with the highest idea, or the problem which involving its own solution at once renders further ascent impossible, and the thought of any antecedent absurd, and possesses the conditions of solving all other problems—then from this to obtain the idea of the lowest—and lastly, by the two-fold force, a nisus ascension is from the latter and a vis potential from the former to cause the Idea, Self, Consciousness, or the I to rise as a product and as a necessary part of the same series with Body, Organization, &c. ("Physiology" n.p.)

Coleridge follows Kant on how to bring causality in line with reason. Kant writes, "Such a [causal] connection, considered as a series, would carry with it dependence both as it ascends and descends" (*CJ* 372). Like Kant, Coleridge is preoc-

cupied with how a reasoned causality for organized beings is not merely effective at one level, but rather must work whether one ascends to a higher level or descends to a lower one. In this view, when physiology can grapple with higher and lower versions of a nisus, an I can emerge from the lowest form of it. The nisus is both part of the body and part of what allows the self. What allows the difference to occur is the passage of time and organic processes. Note that in keeping with Kant's insistence that we limit our knowledge of things to their forms and appearances, Coleridge frames this nisus as an "idea." Because this idea is "part of the same series with Body and organization," dualism is attenuated, and the phenomena of organization can be correlated to the idea of the self or consciousness. Coleridge argues in the *Biographia* that the self "is groundless; but only because it is the ground of all other certainty" (1: 260), and what he suggests here is that it is the vantage point through which we have consciousness.[57] The idea of nisus, thus, can be the basis for the conceptualization of the origins of a self as individual. As Coleridge remarks, "It will be hereafter my business to construct by a series of intuitions the progressive schemes, that must follow from such a power with such forces, till I arrive at the fullness of the human intelligence" (1: 286). That scheme, the poet insists, is his construction of intuitions. The levels of its analysis nonetheless give it some validity because it is starting to take on the form of a law and won't do so until that fullness has been reached.

Blumenbach was also helpful to Coleridge insofar as he thought that metaphor could be generative for science. In the poet's later marginal annotations to Blumenbach's *On the Natural Differences of the Human Race*, Coleridge argued, "The fault common to the Systems & Systematizers of Natural Hystery (sic) is, not so much the falsehood not even unfitness of the guiding principle, diagnostic or teleological, adopted in each; as that each is taking as the only one, to the exclusion of the others" (*CM* 1: 536). Blumenbach had written, "Although I can on no account admit that ordinary importance and dignity in the theory of the gradation of nature which is so generally embellished and praised by natural theologians, nevertheless I gladly concede that these metaphorical and allegorical games are undeniably useful in facilitating the methodology of natural history" (ibid.). Thinking of physiology as an allegorical game that can be methodologically useful allows more than one leading idea to take root and organize it, lending a plurality of options because what one observes has more to do with the appearance of the thing than the thing itself. With more options on the table, Coleridge thinks that the chances of improving intelligibility rise because metaphor provides asymptotes to totality.

We are now in a position to understand how carefully the imagination must

tread in order to work with reason. Coleridge made a place for ideas as physiological phenomena and indeed explicitly considered "the laws that direct the spontaneous movements of thought and the principle of their intellectual mechanism" (*BL* 1: 91). So that physiology would not become a mechanical cause, but rather work with the will, he postulated the law of vital action as the action of individuation.[58] He therefore considered how "inward experiences" had previously been categorized in terms of the "merely receptive quality of the mind; the voluntary, and the spontaneous," which he thought occupied the middle position between the other two (1: 90), and he names the principle for these distinctions "the absence or presence of the will" (1: 89). One way previous researchers have underestimated the will is by "mistaking conditions of a thing for causes and essences" (1: 123). As he insists, "We are not investigating an absolute principium essendi . . . but an absolute principum cognoscendi" (1: 282). That is, following Kant, his quest was not for principles of being but rather for principles of how we can reliably know something. This meant that any claims of constitution would require the utmost skepticism, or else they risked providing mere imaginative phantoms.

Organicism and imagination stand at the intersection of subject and object; they require for Coleridge a teleology beyond mechanism that can be adduced by a posit undertaken for sake of a specific goal or by the recognition of patterns from which one can infer causal laws. Coleridge thus speaks skeptically of physiological laws in terms of constitution, a word that explicitly hearkens back to Kant's distinction between a regulative and constitutive law. Thus, when he dismisses the reality of the billiard-ball metaphor for ideas, he writes, "No! we must suppose the very same force, which constitutes the white ball, to constitute the red or black; or the idea of a circle to constitute the idea of a triangle, which is impossible" (*BL* 1: 108). Here, the claim of constitution is incoherent. Critics who argue that Coleridge's constructions are constitutive have not taken seriously his skepticism about constitutive arguments. Mere assertions of constitution can only be dogmatism. When he considers the hypothesis that the nerves acquire a disposition to certain vibrations, his tactic is to allow the supposition temporarily, determine whether it conforms to logical possibility, and then evaluate the claim. He insists, "We will grant, for a moment, the possibility of such a disposition in a material nerve" (1: 108). He goes on to waive an initial objection, and "pre-suppose the actual existence of such a disposition," but, in the end, he determines that reason has gained nothing from this pre-supposition (ibid.). He goes on to insist, "The highest perfection of natural philosophy would consist in the perfect spiritualization of all the laws of nature into laws of intuition and intellect.[59] The phenomena (the material) must wholly disappear, and the laws alone (the formal) must remain"

(1: 256). Coleridge's explicit goal then is to allow the material to be seen in terms of formal laws, which, in turn, speaks to the phenomena in the forms that they appear. Only in this way, he argues, will imagination be kept within its proper bounds, and his conditional verb "would," as well as his insistence on the formality of those laws, telegraphs those bounds.[60]

With regard to teleology, Coleridge, on the one hand, adopts providential language, as when he opines that "to us [referring here to the British] heaven has been just and gracious" (*BL* 1: 190). On the other hand, he is mindful that science imposes limits to teleology, and certain claims of preexistence are beyond the bounds of science and would in fact undermine scientific reason itself. He thus insists that, "for to bring in the will, or reason, as causes of their own cause, that is, as at once causes and effects, can satisfy those only who in their pretended evidences of a God having first demanded organization, as the sole cause and ground of intellect, will then coolly demand the preexistence of intellect, as the cause and ground-work of organization" (1: 112). In this regard, Coleridge's definition of the imagination in terms of "a repetition in the finite mind of the eternal act of creation in the infinite I am" needs revisiting. "Repetition" announces the subjective side of things insofar as it is a pattern to be perceived. Moreover, "repetition" suspends teleology insofar as the meaning of this repetition and its function are not clear, although repetition then does offer a parallelism between the human and the divine that licenses correlations between the two kinds of phenomena. Coleridge's avoidance of symbol and underscoring of allegory here—the finite allegorizes the divine—nonetheless leaves open the question of what the allegory is to achieve even as it suspends ontology.

WILL AS POSTULATE

The danger of a physiological imagination was that it might subject everything to corporeal regulation or blind causes. Especially mindful of this problem, Coleridge insisted that the living power "must act in my Will and not merely on my will" (*CL* 25 May 1820, 5: 1235). Not only did he consider the will to be "an especial and pre-eminent part of our Humanity," but also he recognized that there was "more in man that can be rationally referred to the life of Nature and the mechanism of [biological] Organization" (*AR* 135–36). This will was "something more than can be rationally referred to . . . Nature and Organization," but thankfully science had an alternative method of turning to geometrical postulates. Coleridge later comments, "We have begun, as in geometry, with defining our terms, and we proceed like Geometricians, with stating our postulates" (136). Like Kant, he thought the will had to be postulated, or else there was no possibility of moral enfranchise-

ment at all. As he puts it in "Elements of Religious Philosophy," from *Aids to Reflection* of 1825, "Begin[ning] with one or more *Assumptions* . . . is common to all science" and that he "assume[s] a something, the proof of which no man can *give* to another, yet every man may *find* for himself" (136). The bottom line was that, for Coleridge, will explains how life works teleologically according to its own purposiveness, which he frames as individuality. Within the *Biographia*, he notes that "geometry therefore supplies philosophy with the example of a primary intuition, from which every science that lays claim to evidence must take its commencement" (1: 250). Hence, he "assume[s] as a postulate, that intelligence and being are reciprocally each other's substrate" (1: 143), and this postulate allows mind/will to interact with matter.[61]

To this end, Coleridge demands what he calls a "rational physiology" (*BL* 1: 132) that is wary of dualism and of mechanistic theories, but one that turns to postulates like the will and a common substrate between intelligence and being to prevent physiology from being reduced to mechanisms while postulates prevent the imagination from cashing a blank check.[62] As he argues explicitly in his refutation of Hartley's association, "The will, the reason, the judgment, and the understanding, instead of being the determining causes of association, must needs be *represented* as its creatures, and among its mechanical effects" (1: 110). He thus refuses a physiological model that would allow his "muscles and nerves . . . [to be] set in motion from external causes equally passive" and thereby leaving anything like an I out of it (1: 118–19). Coleridge further argues that "the essence of a scientific definition [is] to be causative, not by the introduction of imaginary somewhats, natural or supernatural, under the name of causes, but by announcing the law of action in the particular case, in subordination to the common law of which all the phenomena are modifications or results" (*TOL* 25). The way science pursues cause is to find laws of action that pull together various phenomena. His phrase, "imaginary somewhats," is crucial, insofar as it defines the ontologizing of imaginary entities as a major fault line beyond which science cannot exist. He therefore chides Descartes for his "fanciful hypothesis of material ideas" (*BL* 1: 98). As a result, physiological entities are to be apprehended as hypothetical agents and defined in terms of the laws of their actions, and not just mechanisms and effects. Nor are conditions to be mistaken for causes or laws (1: 110). On the ground, this translates to a correlation of biological phenomena to laws of action and the limits of the claim to the status of representation or form. Here he builds upon Saumarez's rejection of physiological systems like Brunonianism, because they insist that life is "merely an effect of which the action is the cause" (1: v). Coleridge continues, "It must likewise be so far causal, that a full insight having been ob-

tained of the law, we derive from it a progressive insight into the necessity and generation of the phenomena of which it is the law" (*TOL* 25). The claim of causality must produce insight into the production of the phenomena. He warned that "imagination [must] not be left limitless and employed as a mere x y z or substitute for the whole terra incognita of Causation" (*SWF* 2: 913). Once again, Coleridge is shrewder than he has been given credit for being.

Dualism, moreover, must also be contained because mind must have some way of interacting with the body. Not only did dualism threaten the unity of nature, but also it failed to explain how the intelligible and sensible could interact with one another. Coleridge explicitly rejects the idea that a "Principle of Thought and Life was really distinct, as well as mentally distinguishable from the Organic Body" ("Physiology" 94) on the grounds that "organic lesions, or obstructions, exert a disturbing force on the thoughts themselves" (ibid.). Since lesions impacted thought, thought logically must at least supervene on the material. He added in the *Biographia*, "The mind is affected by thoughts, rather than by things; and only then feels the requisite interest even for the most important events, and accidents, when by means of mediation they have passed into thoughts" (1: 31). Although he uses the term "mind" here, which might suggest dualism, he emphasizes the feeling that surrounds thought, and thereby allows thought to have corporeal impact.[63] At the same time, because, as Seamus Perry notes, any monism also comes with the threat of determinism (79–81), Coleridge never allows any unity to remain stable.

BIOGRAPHIA

Although critics of the *Biographia* and of the poet's theory of imagination have been obsessed with determining its success or failure in harnessing the unifying powers of imagination, a physiologically attuned understanding of the imagination recognizes how physiology provides a model for Coleridge's thinking about life and organicism, and the relationship between imagination and reason. It is less the product that matters than the process put in place for imagination and reason to produce knowledge. A central focus of the *Biographia* is to understand the difference between the real, what can be proven as real, and the imagined. Without knowledge of these differences, no knowing is possible. A rational imagination has the added benefit of recognizing the difference between hypothesis and knowledge, and the recognition of a gap between the two serves as a necessary condition for the seeking of kinds of verification or confirmation, be they experiment, logical reasoning, or the finding of patterns that suggest laws of action.

Coleridge's critics have long known that one of his goals in the *Biographia* was to prove his own unlearned genius. What has gone unnoticed is that he simulta-

neously claims physiological science and genius, and he can do so because, although genius operates spontaneously by unconscious rules and thus would seem to be outside science's grasp, physiology has methods for extrapolating rules and laws from patterns of phenomena. Thus, life can be indicated by showing that a law of individuality applies to living things. Coleridge writes, "Even natural science, which commences with the material phenomenon as the reality and substance of things existing, does yet by the necessity of theorizing unconsciously, and as it were instinctively, end in nature as an intelligence; and by this tendency the science of nature becomes finally natural philosophy, the one of the two poles of fundamental science" (*BL* 1: 256–57). Here, science begins with material phenomena, only to unconsciously theorize those phenomena as if nature were intelligence, and in this way natural science and natural philosophy combine to produce knowledge by pursuing the poles of object and subject. In the process, unconscious principles can reveal both what we need in order to know something and patterns in the relevant material phenomena, which is to say that nature and our minds are to be read as forms. When Coleridge insists that "in all acts of positive knowledge there is required a reciprocal concurrence of both, namely of the conscious being, and of that which is in itself unconscious" (1: 255), he allows science, too, to partake of genius, despite genius's debts to the unconscious, and he defines the form in terms of reciprocal concurrence. He posits simultaneity and reciprocity, implying there is some kind of ecology between the two, but crucially once again refuses identity.

In the chapter on the irritability of men of genius in the *Biographia*, Coleridge further defends genius against solipsism and turns to physiology to do so. Although he makes a distinction between an author and a man—he argues that, where the author tempers irritability, the man is ruled by it—Coleridge hopes that all men will learn the wisdom of a "calm and tranquil temper" (1: 33), a precursor to objectivity and to the proper disciplining of imagination. He insists, "What is charged to the author, belongs to the man, who would probably have been still more impatient, but for the humanizing influences of the very pursuit which yet bears the blame of his irritability" (1: 37). While irritability may be physiological, it can be influenced by our pursuits, and those influences are also part of the study of physiology. Of course, Coleridge warns that it is only those desiring to be thought poetic geniuses who are truly irritable, and the condition is to be explained by the fact that irritability is a screen for the knowledge that they cannot attain the reputation they most want. Implicitly, the author and reader of literature can be humanized, and, by understanding the true cause of irritability, something can be done about it. We should expect nothing less from the man who invented the

term "psychosomatic." Moreover, he insists that "true genius" bears a sensibility beyond one's own "personal interests" (1: 43). Because genius of the time is being defined as not capable of being learned, this indifference to self-interest was the only thing keeping it from being totally self-absorbed. He elaborates, "The man of genius lives most in the ideal world in which the present is still constituted by the future or the past; and because his feelings have been habitually associated with thoughts and images, to the number, clearness and vivacity of which the sensation of self is always in an inverse proportion" (1: 43–44). Not only does Coleridge seek to remind readers that sensibility does not necessarily entail mere selfishness, but he also highlights how both paying attention to the right habits and distancing oneself from the immediate needs of the self can influence at least the meaning one makes out of one's physiology, if not the physiology itself.

I now show how Coleridge's physiologically informed definition of the imagination entails a performative demand: one whereby the active reflection on elements of the definition helps to articulate the imagination's tendency toward individuality. That is, the act of reasoning about the imagination must inform how to connect intuitions with concepts, but those connections must remain hypothetical. In the process, Coleridge adopts a Kantian strategy to insist upon a transcendental deduction of the idea of an organism in terms of individuality. Coleridge's insistence that physiology is about the "tendency to individualize" confronts mechanism's emptying out of the self. And having heard Kant's worry that claims of purposiveness might speak only to our explanations, Coleridge suspends the question of "whether any other philosophy be possible, but the mechanical; and again, whether the mechanical system can have any claim to be called philosophy" as "questions for another place" (*BL* 1: 106–07). To this end, Coleridge introduces new vocabulary, or at least tweaks the common meanings of words to prevent stale associations and foster new ones, going so far as to "re-introduce . . . objective and subjective" (1: 172). Cognizant of the fact that the words had earlier meant the reverse of their contemporary meaning, with "objective" earlier referring to the thing as constituted through the perceiving mind and subjective referring to the object of thought, Coleridge tracks both subjective and objective elements of his argument, hoping that both together will provide at least insight into a possible parallelism, which, in turn, may provide a glimpse into the absolute. Coleridge insists that nature "is the sum of all that is merely objective," and he defines the "objective" as "comprising all the phenomena by which its existence is made known to us" (1: 254). Here, the objective is epistemological and not ontological; it is equivalent to a phenomenality that makes us aware of existence. Thus, when Coleridge brackets his definition of imagination by framing it in re-

lation to himself, he demands that readers adopt a similar distancing and reflection. Coleridge insists, "I consider," "I hold," and "I consider," and his definition evolves into a stance framed around a looking subject. The definition preserves both subjective and objective poles by stopping short of synthesis, leaving space for the imagination to straddle.

Coleridge thus explicitly positions himself between the transcendental philosopher and the natural philosopher. The problem with the transcendental philosopher is that she or he "is anxious to preclude all interpolation of the objective into the subjective principles of his science, as for instance the assumption of impresses or configurations in the brain" (*BL* 1: 258). The transcendental philosopher's knowledge is subjective in the sense that it is about the forms and appearances of the thing. The natural philosopher, by contrast, "directs his views to the objective, [and] avoids above all things the intermixture of the subjective in his knowledge, as for instance, arbitrary suppositions or rather suffictions, occult qualities, spiritual agents, and the substitution of final for efficient causes" (1: 257). Both systems avoid synthesis; hence, Coleridge insists on a parallelism of the subjective and objective, but one that preserves difference. As he puts it, "All knowledge rests on the coincidence of an object with a subject" (1: 252).

Coleridge's reliance upon a "coincidence" of subject and object and not an identity between the two is significant, because "identity" would mix fundamentally different epistemological categories.[64] He adds, "during the act of knowledge itself, the objective and subjective are so instantly united, that we cannot determine to which of the two priority belongs . . . While I am attempting to explain this intimate coalition, I must suppose it dissolved" (*BL* 1: 255). Here, unity is a product of the act of knowing, and Coleridge resolves that he must "give hypothetical antecedence [to the one], in order to arrive at the other" (1: 255).[65] And because the imagination, according to Kant, functions at the pole of the subjective by offering a unified self, and at the pole of the objective, insofar as it unifies the manifold of sensations, it alone bears the responsibility for unity at both poles. Only a "strict skepticism" can lead us to and preserve this "coincidence," which enables a correlation that is a basis for the hypothesis of causality but refuses to assume correlation is identity.

We can witness this skepticism at work in at least two ways. Coleridge's stance toward common sense bears explanation because it effects how reason works with imagination. He submits that common sense "is not indeed entitled to a judicial voice in the courts of scientific philosophy; but whose whispers still exert a strong secret influence" (*BL* 1: 131). He goes on to praise Wolff, "the admirer, and illustrious systematizer of the Leibnitzian doctrine, [for] content[ing] himself with de-

fending the possibility of the idea, but . . . not adopt[ing] it as part of the edifice" (1: 131). The upshot here is that while common sense cannot adjudicate, it can influence the scientist to recognize that the proof of something's possibility is perhaps an insufficient basis for making it part of the system. Once again ontology is off limits; Leibniz garners praise for not "adopting it as part of the edifice." Coleridge's stance with regard to causation is equally skeptical. "Whenever we . . . pierce into the adyta of causation; and all that laborious conjecture can do, is to fill up the gaps of fancy" (1: 107). His use of the Greek word *adyta*, meaning "innermost sanctuary" and implying something not to be entered, warns that claims of causation might be equivalent to religious superstition, and that laws are only a form of causality. Note how he limits the powers of conjecture to the mere filling in of what fancy left out and thus implies that conjecture alone is insufficient and cannot be considered knowledge. Finally, he acknowledges that the supposition of antecedence is a methodological necessity, because one needs a place to begin.

Let us now consider Coleridge's own individuality. Read in light of physiology, the *Biographia* postulates a will so that Coleridge's story of individuation can be told and so that particulars can be narrativized by a guiding principle. What follows is "Sketches of My Literary Life and Opinions," and thus the poet must sort out how to distinguish what is his from what is everyone else's. Coleridge is careful not to claim singularity as a writer until after having reviewed Greek, Roman, and British literary history. "Though I have seen and known enough of mankind to be well aware," he writes, "that I shall perhaps stand alone in my creed, and that it will be well, if I subject myself to no worse charge than that of singularity; I am not therefore deterred from avowing, that I regard, and ever have regarded the obligations of intellect among the most sacred of the claims of gratitude" (1: 15). His syntax is telling, shoring up the pronoun "I" around a sea of others even as he defines singularity in terms of "obligations" (ibid.). "Gratitude" implies that the obligations have been consciously recognized and embraced. Coleridge intends for this blanket "gratitude" to insulate him from the charges of plagiarism. Singularity can be shown only in relation to context, and such a maneuver replicates the very etymology of "individual," which means "that which cannot be divided from." Note that Coleridge turns to singularity as a concept, a designation, instead of an attribute. Because the very ground of singularity makes singularity in the sense of complete originality impossible, it transforms method in this case to an endless loop that is the *Biographia*. Such a loop also equates to a drive toward individuation that is equivalent to life regardless of whether that individuation has been fully accomplished: the gap between accomplishment and the principle will end only upon death.

Coleridge thereby simultaneously reduces the conditions of success for individuation to the existence of the life drive and converts singularity into a concept that can be instantiated only as a verb. Analogously, when he connects imagination to the infinite "I am," he transforms it into a being without end, which is to say an ideal being. Life as individuation allows being to be accessed by method, thereby allowing being and truth to be reconciled if only because they are both beset by the same problems. Likewise, he argues that what looks to his critics like an absence of judgment was really a youthful inability to realize that judgment. Coleridge insists, "My judgment was stronger, than were my powers of realizing its dictates" (*BL* 1: 8). Because "judgment" here stands in for a kind of unlearned genius whose absence is not an absence of judgment itself but rather the powers of realizing it, Coleridge underscores his youthful genius by insisting that the potential was present if only critics knew how to recognize it in its incipience.

The angle physiology imposes on this quest is, given that human beings share a physiology, how does one know what is mine? Coleridge's insistence upon distinguishing between the subjective and objective and yet bringing them together as coincidence while refusing identity helps him address this question, as it demands that we keep in mind the difference between concepts that are necessary to our understanding and things that fundamentally are exterior to ourselves, and thus unknowable as things in and of themselves. From Coleridge's perspective, being cannot be understood without the concept of individuation, which, in turn, cannot be understood without some sense of the development of intelligence. Likewise, truth cannot be guaranteed by what Coleridge refers to as our instinctual reaching for it, but this instinct, to the extent that it can be proven, suggests that being is somehow regulated by it.

The first step was to recognize that one's claims about things were about their appearances and forms. Following on the heels of Descartes and borrowing from Kant's argument that existence is not a predicate, Coleridge asks himself, "What proof I had of the outward existence of any thing?" (*BL* 1: 200). He poses as an example "this sheet of paper, as a thing in itself, separate from the phaenomenon or image in my perception" (ibid.). All Coleridge knows is the phenomenon of the image of his perception, and thus everything imagined must be bracketed by appearance. While Descartes took existence as a predicate for God, Kant argued that "proving the existence of a God by such means is a mere circle, a delusion" (1: 201). Coleridge shows his partial allegiance to Kant by framing this discussion under opinions. He also makes sure to correct Descartes's claim that if given matter and motion, he could "construct . . . the universe" (1: 297). Coleridge responds, "We must of course understand him to have meant; I will render the construction

of the universe intelligible" (ibid.). Where "construct" implies an ontology that Descartes cannot deliver, the construction of intelligibility is possible and is indeed the appropriate goal for a natural philosopher.

Once phenomenality is front and center, Coleridge can proceed to step 2, to insist that the descriptions of phenomena merit influence only to the extent that they generalize discrete particulars into laws that hold insight or general intelligibility.[66] Laws must perform intellectual or scientific work, or else they devolve into mere dogmatism or fantasy.[67] Moreover, this work must be capable of being evaluated. He thus underscores the fact that "geometry . . . supplies philosophy with the example of a primary intuition, from which every science that lays claim to evidence must take as its commencement" (*BL* 1: 250). Even empiricism relies upon foundational intuitions, and here Coleridge has anticipated philosopher Bas van Fraassen's argument that since empiricism, on the one hand, mandates that all things be verified through experience yet, on the other hand, cannot subject its primary postulate to its own rule, it is a stance, a way of looking at the world, and not a coherent philosophy. Nitsch had defined empiricism as an ideal, never to be reached (Class 39). From Coleridge's view, Abernethy had thus erred by "solv[ing] Phaenomea by Phaenomena that immediately bec[a]me part of the Problem to be solved" (*CL* 4: 809). One also needed to take care not to subordinate final causes to the efficient cause (*BL* 1: 116). We should note here that since Coleridge names the final cause of physiology with Saumarez's help as the development of intelligence, the goal of intelligibility prefigures, but does not deliver, God as the final cause of a rational universe and the origin of the teleology of life. He would go on to argue in his *Theory of Life* that the principle had to access the conditions of the thing's very possibility (35–36). Above all, what matters is that knowledge "will be known by its fruits . . . and by the insight[s] into the nature of the facts it is meant to illustrate" (35). By framing the insights that result from knowledge as the confirmation of the value of that knowledge, Coleridge renders knowledge a process that must be continuously reaffirmed rather than an end product.

The key then is to be able to apprehend phenomena as the form of laws, because that apprehension will lend the most insight. In the *Biographia*, he argues, "The highest perfection of natural philosophy would consist in the perfect spiritualization of all the laws of nature into laws of intuition and intellect. The Phaenomena (the material) must wholly disappear, and the laws alone (the formal) must remain. Thence it comes that in nature itself the more the principle of law breaks forth, the more does the husk drop off, the phaenomena themselves become more spiritual and at length cease altogether in our consciousness" (*BL* 1: 256). Here Coleridge regards materiality in terms of phenomenality, but phenomenality is

only as good as it gives access to the laws alone, which ultimately point to, but do not manifest, the divine. The phenomena, after all, cease "in our consciousness," not in the world. Where in his physiology manuscript he turns to the nisus to move from one level to another and back again, here he implies that, seen rightly, nature is a version of intellect and being is a version of truth, with form being the common ground between the two and the only possible object of knowledge. Crucially, however, form is bracketed as an appearance, and Coleridge frames his speculations as hypotheses. The problem is whether this higher perfection is reachable, and we should note that the passage is bracketed by the conditional verb "would," once again putting the brakes on ontology. Whether law stands on the side of the subjective or the objective, however, is another matter, and Coleridge stipulates that the law must be pursued from both vantage points.

Step 3 demands a turn to intuition or spontaneity. Although Coleridge insists our knowledge gives us access to phenomena and not things, that does not prevent him from including things in his system and turning to intuitions as a sign of access to the final causes behind those things. When he elaborates upon a distinction between the notional and actual, he makes clear that although the actual cannot be known, his verb is "contemplated," and one might say imagined. The actual thereby becomes a posit. Coleridge explains himself this way: "When we have formed a scheme or outline of these two different kinds of force [say, attraction and repulsion or the basis of matter], and of their different results by the process of discursive reasoning, it will then remain for us to elevate the Thesis from the notional to the actual, by contemplating intuitively this one power with its two inherent indestructible yet counteracting forces, and the results or generations to which their interpenetration gives existence, in the living principle and in the process of our own self-consciousness" (*BL* 1: 299). Note his rigid adherence to the differences between thought and things; and the fact that this statement occurs in chapter 13, "On the Imagination," suggests that this divide is crucial to understanding what the imagination is supposed to do and what it should be prevented from doing. On one side is the work of mind: schemes we have formed, outlines, discursive reasoning, the notional, and intuitive contemplation. On the other side is the need to elevate the mere notional into something called the "actual" and existence: thought alone is insufficient without the ability to consider existence. And yet, because these variants of thought all contribute to the possibility of our cognizing existence and make our experience of things possible, they contribute to actuality, which can, in turn, be seen in the forms of the living principle and self-consciousness. "We," after all, are what elevate, and as a result all the ensuing nouns refer to forms of our elevation. Coleridge thus repeatedly

brackets knowledge of things as thoughts, and, by extension, the proper role of imagination is to remind us of how its powers of synthesis get us in touch with an actual in the form of a posit that must be felt or "intuited" in terms of existence. When Coleridge combines the immediacy of intuition with contemplation, he insists on active imaginative synthesis of both subjective and objective sides, as well as the need for intuition to offset an otherwise sterile rationalism. He includes a translation of Kant's argument that we must remember that the noncoincidence of the sensual and intellectual is a limitation of the human senses, and not a claim about the inherent limits of things (*BL* 1: 289). Nonetheless, a rush to ontological conclusions would be a mistake.[68]

Coleridge's famous definition of the imagination thus functions like a Kantian idea whose goal is not ontology but insight, and true insight can rarely be had with lawless speculation.[69] Among numerous others, James Engell, Trevor Levere, and Pamela Edwards have influentially argued that Coleridge thought ideas and laws were constitutive and therefore partake of the life and being of the world (Engell 340; Levere, *Poetry Realized* 98–102; P. Edwards 146), but this is to leave behind all of Coleridge's epistemological concerns, along with his recognition that even if he believed ideas and laws were constitutive, science had to have means of evaluating claims of constitution.[70] Coleridge thereby not only brackets much of his remarks about the imagination as speculation but also keeps the imagination within the law by insisting on the limits to it. In keeping with a kind of Kantian modesty about what we can know, the stance of being and that of truth are just that: stances, and these stances are dynamic. Too, consider how he deploys essence when speaking about imagination. "It is essential vital," Coleridge proclaims, "even as all objects (as objects) are essentially fixed and dead" (*BL* 1: 304). How can the imagination be both essentially vital and dead? It is therefore the stance from which one views the imagination that keeps it conforming to reason and laws even as the poet recognizes the subjective and objective as stances.

To wit, Coleridge refrains from making claims about the agency of the imagination but rather stipulates that he "holds" and "considers" this agency, thus bringing it in line with something that he has apprehended; and thus purposiveness or agency or vitality are always potentially the ideas necessary for human understanding. By having the subject look at part of the subject, being has the potential to become knowing. Readers thus can evaluate what his apprehension accomplishes and whether it provides intelligibility. The categories of "primary" and "secondary" are his likewise his categories. The "primary" he "hold[s] to be the living Power and prime Agent of all human Perception, and as a repetition in the finite mind of the eternal act of creation in the infinite I am" (*BL* 1: 304). On

the one hand, imagination is the agent of all perception, and the framing of this statement allows for the will because the imagination is not allowed to remain merely passive. On the other hand, it is a pattern, a repetition, that allows correlations between the finite mind and God. Whatever truth the imagination holds is only as good as the claims about its being, as its being is framed in terms of an overall physiological quest for individuation, one itself driven by the need for physiology to permit the development of mind and imagination. Perception and creation are mutually implicated, designating the possible ground of where being and truth may be correlated but not made into an identity because the figure synthesizing them is a "repetition," which exists only in the perceiver and insists upon temporality. It is the reader's responsibility to decide what the meaning of these correlations are, but one must neither assume them to be an identity nor take for granted that identity is impossible. Again, a repetition is not an identity.

With regard to the secondary imagination, note that Coleridge defines it first it terms of an echo, which again insists upon the role of the active perceiver and prevents claims of identity. He famously writes, "The secondary I consider as an echo of the former, co-existing with the conscious will, yet still identical with the primary in the kind of its agency, and differing only in degree, and in the mode of its operation" (*BL* 1: 304). All these stipulations are taxonomic categories from the stance of the perceiver (hence Coleridge's simile), and now the question becomes, what do these designations offer? Coleridge claims coexistence, meaning that one is not the cause of the other, and he remains highly aware of the acts of substitution necessary to imply coherence. To grasp the significance of Coleridge's distinction between kind and degree, we should recall his warnings about how not to define life. He criticizes one definition because it "confounds the Law of Life, or the primary and universal form of vital agency, with the conception, Animals. For the kind, it substitutes the representative of its degrees and modifications" (*TOL* 26). Instead, Coleridge stipulates, "The first and most important office of science, physical and physiological, is to contemplate the power in kind, abstracted from the degree" (ibid.). To do that, one needs comparisons across species to arrive at a possible law. Nonetheless, this law must be the outcome of struggle, with imagination learning to work spontaneously with reason as it apprehends phenomena as laws. And, as reason turns to taxonomy, Coleridge submits, one must evaluate whether the will has been given its possible due.

We should then note that his distinctions between two kinds of imaginations, the primary and the secondary, demand twoness, which in turn demand two acts of abstraction into laws, one for each kind. Abstraction is where the will can do its work and where phenomena can become law. Abstraction is further where the

determinism of any seeming mechanism can be overcome. The primary means that the acts of perception and creation be abstracted into a form of synthesis. The secondary requires a different degree and mode of operation than the primary and is an echo of the former. He thus insists upon making the imagination both singular and plural, with "echo" insisting at least upon a temporal delay with regard to the secondary imagination. The abstraction of two kinds, which are perhaps more relations of degrees than kinds, imposes a dialectic between degree and kind that has the potential to enact a synthesis whereby difference is allowed to retain some difference. As J. Fisher Solomon puts it, "Do we not then have here a certain power with its own differentiating capacity which is never 'outside' it, a neither singular not plural 'being' that we might equally call 'power and difference'?" (148). If the power indicates a universalizing capacity for law, difference underscores our inability to know the law outside of the empirical phenomena that would seem to indicate it. Hence Coleridge's insistent preservation of difference. And hence Coleridge's recognition that the imagination "struggles to idealize and to unify" (*BL* 1: 304); only by remembering that struggle do we recognize that the perception of unity is the ongoing work of imagination. Crucially, this does not bankrupt that unity because the imagination participates within physiological laws that point to potential future unity and higher meaning.

From the stance of his apprehension, then, Coleridge sees imagination "dissolve, diffuse, dissipate, in order to recreate," and in all these present-tense verbs he highlights process so the imagination remains vital and does not become a passive object. He ends the definition by referring to the fact that "all objects (as objects) are essentially fixed and dead" (*BL* 1: 304), thereby advertising that his stance preserves the possibility of the power of the will but does not guarantee the efficacy of it. Above all, Coleridge frames the imagination from the standpoint of a subject looking at it, and whatever intelligibility results from this act of looking speaks more to the active apprehension of it than the object itself, but the active apprehension of imagination does not paper over the object. In sum, then, the very definition of imagination models the kind of cooperation of reason and imagination, truth and being, that the *Biographia* seeks to put into place, a cooperation where the limits of understanding are always paramount and existence is never allowed to be a predicate, except as a state of becoming. Physiology not only gave him models for finding this cooperation but also made clear the stakes for minting imaginative phantoms. The fact that it remains just a model underscores the capacity of imagination to work with reason and reminds readers of the need to both perform and evaluate it. Surprisingly, the speculative physiology of the time explains how that might happen.

Attention to Coleridge's physiological understanding of imagination thus upends a number of influential critical assumptions about it and demands a more nuanced sense of what both Romantic science and the Romantic imagination were about. If critics like Jerome Christensen have embraced a deconstructive theory of language that gives us a Coleridge both who fails to be unified by his theory of imagination and who is entrapped by marginal and discursive practices that enable a machinery of language to destroy anything like the will, attention to physiology provides a much more modest Coleridge who is worried less about ontology than he is about developing a system that both makes the intelligibility of nature possible and helps develop the mind by understanding the imagination's proper role. That proper role is contingent upon the poet's insistence upon difference. Coleridge asserted that the office of the imagination was to "struggle to idealize and to unify" (*BL* 1: 304), and thus deconstruction misunderstands Coleridge's project. The central question is hardly the degree to which language can assist in this process. Nor is the issue whether the imagination empirically unifies anything. Coleridge's worry, by contrast, is the extent to which imagination will grow to enable both the apprehension of reason and final causes along with the operationalization of reason and imagination. The historicist project has unhelpfully taken on board both the deconstructive suspicion of the imagination and an understanding of ideology as language masking itself as nature, which allows it to tar imagination with the same brush as ideology. These assumptions do not account for how Coleridge learns from physiology to define imagination fittingly in terms of a postulate that invites action, and how he turns to organicism as a heuristic so that its spontaneous intuitions create the conditions for the full development of intellect. Such organicism could be proven to be a law only once one had a clear sense of the phenomena it enabled one to bring to order. The Romantic imagination could not afford not to work with science and thus must cooperate with reason. It therefore is far more modestly framed and rational than criticism acknowledges.

Physiology, thus, does nothing less than model for Coleridge what cooperation between imagination and reason looks like. Imagination will usurp reason's place if it invents entities that have no possibility of actuality and mistakes what happens as a result of our abilities to apprehend things as properties of the thing. Yet, because imagination and vitalism, like genius, work unconsciously, Coleridge learns from physiology how to correlate phenomena with laws so that he can have either a posit that results in a moral system or a hypothesis that can perform meaningful work instead of sending us on wild goose chases, thereby substituting fantasy for creativity.

CHAPTER 4

Obstetrics and Embryology

Science and Imagination in Frankenstein

While *Frankenstein* has long been seen as a birth myth, we have yet to unpack how the place of imagination within obstetrics and embryology shaped Mary Shelley's thinking about imagination, creation, and science. She explores the act of "conception," a term that regularly referred to both to acts of imagination and of reproduction, to think about how both are embodied yet too often reduced to a replication, the creation of something or someone that is merely a version of oneself.[1] To wit, although critics generally assume biological creation to be something new, theories of the time reduced it to a form of copying, and women's contributions to generation were minimized.[2] In this view, sexual difference did not make a difference. From the time of Aristotle, women's contribution to generation was limited either to being the nest for the fetus or to providing the dead matter to be activated by the man's seed. Even under Harvey's ovism, where everything originates from the egg, the theory of preformation denied or slighted women's contributions because, while the female is the matrix of life, the male is its source. This was true except in the case of monsters, what we now consider birth defects, which were often thought to be the products of the uncontrollable female imagination alone. Monstrosity, then, is a way of pathologizing difference and women's contributions to generation.[3]

This reduction of conception to copying is allegorized within the history of imagination itself, and one of the persistent questions posed about it is, could it do more than combine elements stored in our memories? Alan Bewell has analyzed midwifery manuals of the period and has argued that obstetrics and its insistence upon a mimetic imagination forms the master code of Shelley's aesthetics and the basis for her critique of the masculine imagination ("Issue" 108). I will

show, by contrast, how obstetrics and embryology shaped the discourse of imagination in ways that Shelley challenges. For her, although framing the imagination as an organically embodied entity responsible for the birth of her "hideous progeny" granted it the powers of development, the metaphor of birth dangerously foreshortens the creative process by separating conception from development and by giving far too much credit to the initial conception while undermining the impact of social relations. Because Victor anticipates worship by his creature for its creation, he doesn't give a tuss about parenting or development. Why bother when conception is mission accomplished? Shelley also worries that obstetrics and embryology frame creation in such a way that self-replication or narcissism is the only version of autonomy possible, and, to the extent that science is moving in the direction of reproducibility as a scientific standard, she mourns the implications of this for creativity and imagination when she recounts, even as a child, the boredom of being trapped in her own sensations. She insists, "I could people the hours with creatures far more interesting to me at that age than my own sensations" (193). The *Oxford English Dictionary* suggests that "reproducibility" is a Victorian invention and credits its earliest use to J. F. W. Herschel.[4] This has implications even for science and art, since, although scientists and artists could not do without the generativeness of imaginative connections, it was both the moment of creation or discovery that mattered and the kind of work that ensued from it. In so doing, she must confront the ways in which culture tries to map gender onto creation and to make the labor of childbirth something that requires male intervention. She thereby tries to figure out how science can reliably turn to imagination to do its exploratory work, and how the imagination's creations can move beyond the mere reproduction of ideas. This collapse is further evident within the history of epigenesis, which paradoxically is "a developmental theory without development" (Wellmann 94): the traces of how the theory came into being have been expunged. I construe this absence as the suppression of the imagination's exploratory work.

Obstetricians were keen to rationalize science at the expense of the female body. Mary Shelley, by contrast, shows that the male gender has no necessary superior powers of rationalization because it is no less embodied, and she does so by making Victor Frankenstein controlled by his imagination instead of controlling it. This maneuver reverses the then-dominant tendency of some men-midwives to conflate female wombs with female imaginations on the grounds that both were irrational and unpredictable.[5] This gendering, in turn, licenses men-midwives and their technology to hijack the birthing process and women's bodies as well as to define female labor as monstrous to exonerate themselves. At a minimum,

Shelley shows that obstetrics could benefit from a little modesty and not take for granted its assertion that it alone had mastered science and technology, as if those forms of mastery would prevent death.[6] From Shelley's perspective, while rationality had its strengths, it could not anticipate in advance how to solve the major mysteries of generation but rather had to work organically in cooperation with the imagination, making "mastery" impossible. For one thing, Shelley herself suffers from "the greatest misery of authorship . . . the blank incapability of invention" (195).[7] For another, while the imagination was widely recognized as a source for generative ideas, the scientific value of those ideas was often questionable, even more so because what counts as a scientific idea cannot be set in advance. To wit, Darwinian evolution is not testable in any strict sense, and yet it is perhaps one of the most important scientific ideas ever. Nor could discovery and invention be reduced to a method. Third, despite the fact that men-midwives had largely debunked the idea that the female imagination was responsible for monsters, they acknowledged that women's belief in the power of their imaginations could have negative effects, and thus the psyche had uncanny powers over bodies that might be managed but not fully understood. Finally, she insists that scientists and men-midwives need a reflective sensibility, even as she warns that feelings can be manipulated. The bottom line is that Victor's imagination has no chance of proper development or improvement, and Shelley wants to show us why.

Shelley underscores the analogy between mental and physical generation in her 1831 preface to the novel when she stipulates, "Invention, it must humbly be admitted, does not consist in creating out of a void, but out of chaos; the materials must, in the first place, be afforded: it can give form to dark, shapeless substances, but cannot bring into being substance itself" (195). In reframing origins not as a void but in terms of chaos, she focuses the study of conception on the materials one has to work with, and how those materials can be modified, even as she wonders about how far we will ever see into the chaos. The mind and womb were black boxes, especially since the messiness of wet flesh resisted any transparency. Victor's assemblage of the monster from parts of dead bodies therefore allegorizes both the limits of thinking about imagination as creation/conception, which has no way to deal with the issue of inheritance (Müller-Wille and Rheinberger 16), and the problem of how some matter becomes organic. In this view, if what Shelley refers to as form without substance is what permits traffic between biological science and fiction, it runs the danger of making both into science fiction. Perhaps this is why in 1831 she relegates the imagination to a childish pursuit of "castles in the air" (192).

Yet, in the same way that embryologists like Blumenbach and von Baer began

to realize that the source of organization was a dead end because it raised metaphysical questions unanswerable by science of the time, Shelley's focus on materiality moved both generation and imagination away from origins and toward examination of organic processes of development.[8] She elaborates, "Invention consists in the capacity of seizing on the capabilities of a subject: and in the power of moulding and fashioning ideas suggested to it" (195). In this way, the imagination spontaneously encounters potentiality rather than imposes upon it already preformed ideas. Generation and monstrosity were shrouded in mystery, but Karl Ernst von Baer found a way forward, and that was to compare development across living forms to see what laws might govern it.[9] By the end of the Romantic period, he was able to proffer laws of development that are credited with making embryology into a real science, and he accomplished this by comparing the development of the embryo to the descent and development of the species. Crucially, he knew neither the outcome nor the range nor even the usefulness of the comparisons in advance.

My claim is that obstetricians and embryologists of the time begin to understand that with so much unknown about generation and embryonic development, the imagination had to provide leads.[10] Blumenbach had noted the existence of at least 262 "vague hypotheses on generation" (*Essay* 4). The obstetrician Alexander Hamilton acknowledged the numerous hypotheses surrounding conception and praised the "learning and brilliancy of imagination which have extinguished the several combatants" (*Outlines* 62–63). Here the imagination is used to take down the theories of one's opponents, and it achieves this by helping to envision the logical consequences of these ideas. The imagination's leads were all the more necessary once embryology turned away from preformation and toward epigenesis, as it did in the Romantic period. Preformation was all the rage from 1670s until the 1750s, in part because it confirmed Calvinist ideas of predestination and in part because it posited no creation (no competition with God) but rather a simple enlargement of what was already there (McLaren 334–35). With regard to embryology, there was the huge question of what exactly was development. Seeing in terms of development means seeing imaginatively because one must break development into forms of differentiation, but which differences counted? Thus, von Baer distinguished "tubes" from layers and named them "fundamental organs" (Wellmann 303). At the same time, he came up with his principle law of development: "There is nowhere new formation, only transformation," and this meant that all the differentiations of the body's tissues and organs were not absolute but relative, and this meant that what was visible was also in process (305).

EPIGENESIS AND THE FRAME PROBLEM

Preformation and epigenesis posed a huge problem for the imagination's role in science. Because the absence of visual evidence could be explained both by theories of preformation and epigenesis, how did one know what was imagined and what wasn't? As the controversy between Albrecht von Haller and Caspar Friedrich Wolff showed, the absence of empirical evidence could point either to a preexisting form that was there from the beginning or a vitalism that insisted upon the limits of empirical evidence itself.[11] Spallanzani adhered to preformationism, despite the fact that his own evidence was highly ambiguous. Did development entail a coming into being of a form that was always there but being infinitesimally small could not be recognized, or did homogenous matter require something like vitalism to unfold itself?[12] Malebranche, the founder of preformationism, had earlier argued that "one of the main errors we fall into in physics is to imagine that there is more substance in bodies that are perceptible than in those that are hardly perceptible at all" (17). With this, Malebranche opened the door to the existence of highly organized beings that could not be seen and ironically made the correlation of the visible with substance a figment of imagination.[13] In focusing on form without substance, does Shelley align herself with Malebranche, or does she critique him? Wolff seconded Malebranche, insisting that "one cannot well say that what is not accessible to our senses is therefore non-existent" (cited in Gasking 103).[14] Since both sides of the debate pointed to the other side's overactive imagination along with the failings of human senses, the problem was to figure out how to know which side, if either, was right. The problem was made more intractable because, irrespective of any scientific gains, obstetricians especially literally could not afford to ignore how their contributions helped to make gender more intelligible, as their fees were high. When von Baer claimed that younger embryos were simply coarser in outline than older ones, and therefore miniature forms do not exist, he dealt a fatal blow to preformationism (Churchill 10).

Perhaps because the object of study was so difficult to put into view—the poor state of compound microscopes did not help—and because the meaning of what was unseen was open to debate, men-midwives and embryologists turned to disciplining the imagination and the subject possessing it instead. To discipline the imagination so that its analogical connections might provide useful leads, these writers pit either an overly passive imagination or a much too active one (both gendered female) against a temperate masculine version of it. An imagination that passively reproduced what was given did not really help increase intelligibility, one of the main goals of natural history. What distinguishes the two is the person-

hood behind the imagination, writ in terms of gender. The precise problem behind the feminized version of imagination was that it allowed this faculty to stand in for personhood itself, either by embracing its images as reality or by precipitously taking on board its trains of associations. This reliance upon personhood had downsides, chief among which was the fact that gentlemanly conduct had become more important than scientific achievement to the Royal Society in the seventeenth and eighteenth centuries.[15] Walton might have been impressed with Victor's aristocratic background, but Shelley is unfazed by it. If objectivity would throw the subject out with subjectivity, it did so by turning the subject's habits and practices into (male) epistemic virtues, except that normally virtues presume a subject to embody them. If we peel back what we now tend to see as objectivity, then, we find the Romantic imagination working to generate ideas, but, as science set its sights on verification, the entity that provided the very materials to be verified got ignored. Charles Clarke, Shelley's obstetrician in 1815, denied the value of "hypothetical reasoning" (vi) in the study of obstetric diseases and sought to replace it with knowledge from touch gleaned from practice. Yet this entailed hypothesizing that knowledge from touch was reliable knowledge. We also find science working through various explanatory systems and trying to discover what science really is and does. In brief, Shelley responds by showing that both gender and sensibility have no powers to immunize the imagination. Moreover, she suggests that science would have much to gain from thinking about Victor's mistakes.

Finally, embryologists worried about a gap between the start of life and a meaningful life, and expressed this worry by making distinctions between form and matter, between the production of organic material and its organization, and among the embryo, the fetus, and the person (Maienschein 16–25). Early in the Romantic period, the soonest personhood was believed to begin was forty days from conception when the mother first experienced the movement of the fetus, a moment called quickening.[16] William Lawrence, Percy's eye surgeon, stipulated that the embryo only had "real life . . . when we are first capable of perceiving" its parts (141). Blumenbach not only ridiculed the "imaginary dignity of the animaculae of the semen of animals" (*Essay* 9), but he claimed that, in the fourth week, the embryo "enjoys an extremely low and languid degree of life, bordering even on that of a vegetable" (*Elements* 1: 201). The ambivalence about the status of the embryo can be seen in the possibility of rationalizing infanticide, as Wordsworth does in "The Thorn," and the perceived need in 1803 to tighten up laws against abortion, which was believed to be widely practiced but was seldom prosecuted.[17] Simply put, if the fetus was without question a person, how could one justify the

failure to prosecute all deliberate abortions?[18] That European Enlightenment science generally considered the embryo to be sexless further highlights a gap between it and personhood (Brooks 41). If preformationists believed that there is a moment when life is already formed and the individual has already begun growing, epigenesists argued that life was a process of continued development, which was why human gestation took so long. Shelley, in fact, denounced both France and England for denying servants "the dignity of a human being" (46), but one question was, exactly when did this dignity begin?[19] When considering forming the female monster, Victor notes that "she . . . in all probability was to become a thinking and reasoning animal" (138), once again separating the creation of life from a meaningful life and ironically undermining his own achievement by highlighting his failed parenting. While his turn to "probability" chalks development up to chance, his imagining of the "horror and suspicion of the peasants" (142) denies them any dignity.

From a current scientific perspective, a gap between form and being is anathema insofar as it would demand a metaphysics that is impervious to scientific investigation. Yet, for Romantic science, this gap was highly generative. For Shelley, the gap was important for several reasons. For one, it suggests that both monstrosity and personhood are largely products of social and not biological development: neither are instantiated with the instantiation of life. Monsters then are not born, notwithstanding Ellen Moers's influential account of the novel; they are made and developed. Hence the abundance of candidates for monstrosity in the novel: Justine, the Turk, Victor, and even "the barbarity of man" (84). Not only does Victor select the parts for his monster strictly out of his own convenience (originally, he considers them beautiful), but also the gap between the ugly form of the monster in contrast to its claim of a sensitive personhood reminds us that forms offer appearances and that morphology, because it downplays biological function, doesn't tell the whole story.[20] Imaginative development, then, becomes a surrogate for thinking about how culture shapes human development. And because narrating development raises all kinds of epistemological problems—how to organize it, how to punctuate it in time, and which resemblances to heed—it requires a disciplined imagination at every step of its own development.

THE PLACE OF IMAGINATION IN OBSTETRICS AND EMBRYOLOGY

What was the place of imagination within obstetrics and embryology, and how might knowing that contribute to our understanding of *Frankenstein*? In brief,

this knowledge helps us evaluate the kind of scientist that Victor is and, by extension, Mary Shelley's hopes for science. When Victor announces that he "collected the instruments of life around me" (38), he plays the role of a man-midwife, but he is tone deaf to how obstetrical "instruments" would have been commonly associated with death. It also helps us to understand how the imagination helped science to operationalize and evaluate its goals. Erasmus Darwin admitted, "The process of generation is still involved in impenetrable obscurity; however, conjectures may nevertheless be formed concerning some of its circumstances" (Z 1: 484). Because so much was unknown, something had to be proposed in an effort to fill in the gaps, and this was for better or worse the imagination. On the one hand, ideas and solutions had to be generated by the imagination. On the other hand, while proving that something was not just imagined helped to generate fodder for experiment or, in the case of midwifery, some sense of what a best practice was, these goals could not be known in advance.[21] Men-midwives were called in only on difficult labors, but how did one know when to intervene with instruments and when to wait for nature to take its course?[22] Was there a set time beyond which intervention could result only in death?

Even when excoriated, then, the imagination helped to define how science might improve, sometimes by negation but always by insisting upon thought as a kind of organic process. This means that the imagination has to spontaneously encounter its objects of study, and that the work of science and rationality were never done. Embryology, thus, sheds light on how Shelley considers development, as the novel features three case studies of development—Victor's, the monster's, and Walton's—side by side. Shelley thereby inserts a frame problem of her own, by offering us three unreliable narrators, all of whom are trying to sanitize themselves as they self-narrate. By so insistently highlighting how the frame shapes the meaning of the narrative, Shelley invites readers to consider how each character develops or fails to develop. By making the imaginations of Victor, the monster, and Walton almost intractable to development, she warns us of the social costs of such failures and invites us to develop our own methods of imaginative discipline. We can do so by adopting a comparative method that seeks laws of development. In this view, Shelley's nested narratives thus allegorize the problem of how to connect empirical particulars to laws. Their nestedness means that the individual cases must somehow be transformed into laws concerning development that enables one to figure out what the signposts of development are. Victor's crude stitching together of the monster's parts, by contrast, is the logical outcome of a cut-and-paste epistemology whereby alchemy is unreflectively grafted onto electricity.

SMELLIE AND MIDWIFERY

William Smellie, "the biggest name in midwifery in Britain, and possibly in Europe" (A. Wilson, *Making of Man-Midwifery* 124–25), grudgingly acknowledged the place of imagination within obstetrics.[23] On the one hand, the advertisement to the fifth edition of his *Collection of Preternatural Cases and Observations in Midwifery* promised that the work "contains directions and rules of conduct to be observed in every case that can possibly occur in the exercise of the obstetric art; rules that have not been deduced from the theory of a heated imagination, but founded on solid observation, confirmed by mature reflection, and reiterated experience." In framing obstetrics as an art and not a science, Smellie was aligning it with careful practice, one where methods and conduct replace a diseased "heated imagination." Victor Frankenstein, by contrast, proudly declares his imagination to have been "warmed" by Agrippa (23). Nonetheless Smellie's modifier "heated" reminds us there are unheated imaginations, allowing for positive contributions. Indeed, Smellie turned to the imagination so that he could modify the forceps. As he put it, he "contrived an alteration in their form" (cited in A. Wilson, *Making of Man-Midwifery* 126). The *OED* repeatedly connects "contrive" to "invent," and the first definition adds that it means "to excogitate with ingenuity or cleverness," bringing it close to "imagine." Victor crucially lacks the discipline to make science into an art.

In his influential *Treatise on the Theory and Practice of Midwifery*, Smellie associates the imagination with the undisciplined ancients and unknowing female midwives, thus feminizing it. He castigates a female midwife for her "ignorant imagination" because she wrongly identified the part that had descended (3: 193). Describing an anxious female patient, Smellie argues that her labor will be "retarded by her uneasiness, which we must endeavor to surmount by arguments and gentle persuasive: but if she is not to be satisfied, and strongly impressed with an opinion that certain medicines might be administered to hasten delivery, it will be convenient to prescribe some innocent medicine that she may take between whiles, to beguile the time and please her imagination" (3: 158). Smellie further warns that "passions of mind . . . require particular attention. The patient's imagination must not be disturbed by the news of any extraordinary accident which may have happened to her family and friends; for such information hath been known to carry off the labour-pains entirely, after they were begun, and the woman has sunk under her dejection of spirits" (3: 293). Smellie considers the female imagination as something to be beguiled, and he thus justifies the male-midwife's trickery over it. He was not beyond "beguil[ing] the time and pleas[ing]

her imagination" (1: 158). Moreover, he urges that the practitioner must careful control any input into the mother's imagination so as to allow her to concentrate on the labor. To help another patient deal with her pain, Smellie writes, "The patient was told, and imagined that it was her labour coming on, by which deception she bore the pain with great fortitude" (3: 115).

When referring to his own imagination, or those of men-midwives, by contrast, Smellie makes clear that it is disciplined by practice and, more importantly, was self-correcting. Smellie wrote, "At first when I examined . . . I imagined . . . that the position retarded delivery, but on a second trial, and introducing my finger backwards towards the sacrum, I found a large open space" (*Treatise* 3: 14). In this instance, Smellie reveals himself to know the difference between his original supposition and his later discovery: the temporal gap between the two and the insertion of his finger suggests an experienced practitioner who had learned his craft or art in the sense of practice. He later "imagines" another mother to have a second child to deliver because she is in pain but discovers that she had only coagulated blood to expel (3: 387). In his *Introduction to the Theory and Practice of Midwifery*, John Leake likewise feminized the imagination, blaming "the generality of women" for continuing to perpetuate the idea that the mother's imagination was responsible for monsters (34). John Clarke, moreover, warned that "much will depend upon the skill of the practitioner in regulating the passions of the mind of his patient, so that their undue influence may not interfere with the regular process of parturition" (*Practical Essays* 15–16).[24]

The manuscript lectures of the man-midwife Thomas Young, circa the 1770s, substantially enriches our sense of the place of imagination in obstetrics and further supports the ways in which male midwifery sets up a female imagination to be disciplined by a male one. On the one hand, Young offers a feminized version of the imagination, one that works in ignorance. The lectures open with his pronouncement that "midwifery lay a long time uncultivated from its being entirely in the hands of women and these the most illiterate, having no education and no skill of the anatomy of the parts" (1). On the other hand, because the man-midwife has to work with parts of generation where so much is unseen, the male midwife must also rely on the imagination, but one supplemented with a wide array of scientific knowledge across species and lots of hands-on experience. Hence, he warns of the importance to "soothe the minds of women and dispel their apprehensions" (169) in difficult labors especially.

As did Smellie, Young also distinguished a feminized imagination from his more masculine one. First, Young claims that women are unaware of variations within menstrual cycles, and thus they turn to their imaginations to make sense

of them. He points out that women do not know that menstruation is often irregular and that this irregularity is why so many women "imagine themselves with child having much the same symptoms as if they were" (81). He dismisses the idea of the mother's imagination imprinting itself on the fetus as a form of female ignorance. Circulation of the body is not controlled by the will, and therefore we cannot "determine greater proportions of blood to one part than another" (141). He adds, "Consequently any support of imagination will never produce a greater luxuriancy of growth in any one part than other much less can it add a limb extraordinary" (142). Next, he argues that "if we allow that a woman by the strength of her imagination is capable of producing a third leg we may with equal reason allow that a stronger exertion of the same power will be capable of forming all the parts of the fetus which in reality is allowing a creative power to a woman's disturbed imagination . . . [N]othing can be more absurd" (142). He continues, "The apprehension of the mother whose imagination may be haunted with the disagreeable idea of some frightful mark being stamped on the child" can have effects (134). Finally, since "deformities are observed in vegetables, they cannot be the effect of imagination" (144). Summing up the dangers of the female imagination, Young writes, "Real evils are often suffered from a foolish apprehension of imaginary ones. This observation is particularly just with regard to a number of pregnant women" (141). Masculine scientific authority came at the expense of women's imaginations, but the mastery of that authority and even its ability to prevent death were very much in question.

Nonetheless, because so much cannot be seen within midwifery, Young has little choice but to call upon the imagination while simultaneously being modest about its fruits. Young tries to figure out where generation occurs and insists, "I imagine it is oftener in the womb than in any of them [fallopian tubes], otherwise we should have extra-uterine fetuses oftener than what we have" (50). Here imagination acquires legitimacy because it works hand in hand with direct knowledge of anatomy. Young also argues against too much confidence in the fruits of imagination and notes that most causes of menstruation have been "imagined" (83). Thomas Denman, the foremost man-midwife in London after William Hunter's death and with whom Mary Shelley's attending obstetricians, the Clarke brothers, had practiced, likewise demanded modesty because men-midwives had too readily invoked the imagination. He argued, "To unsophisticated observation, and to a mere relation of facts, or the inferences plainly deduced to them, men are unwilling to submit, or the powers of the imagination are by such proceeding checked or suppressed, the want to understanding is corrected" (1: 169). Here, understanding depends on the ability to check the imagination. Later, Denham

laments that too often "the imagination hath been indulged with a freedom not very consistent with the dignity of philosophy" (1: 206). The trick was to make imagination commensurate with philosophy's dignity.

When deciding to have Victor give "birth" to the monster, Shelley would have found in obstetrics much inspiration.[25] One potential instance: the man-midwife James Hamilton theorizes that generation occurs when "the semen masculinena is injected into the uterus, [and] the ovum becomes vivified by a vapour arising from it" (88–89). Hamilton frames the uterus as a kind of dead matter that is brought to life by the aura of the male semen, and he justifies this theory with the analogy to oviparous animals whose eggs must be brought to life by contact with the male. Hamilton underscores how Frankenstein's monster is the embodiment of patriarchal theories of generation.

A MAN GIVES BIRTH: THOMAS LANE

Shelley may also have been inspired by the case of Thomas Lane, a boy of fifteen years of age, who in 1814 died after his belly swelled.[26] This case also featured an undisciplined imagination against a soberer one, and it achieved wide notoriety. Mary Wollstonecraft's man-midwife, John Clarke, was one of the subscribers to Nathaniel Highmore's volume, and John practiced alongside his brother, Charles, who was likely Mary Shelley's attending midwife in 1815. John Abernethy was another subscriber, and Percy attended his London lectures on anatomy. Lane's mother claimed that, before he died, he had protested that he had something alive in his body (Highmore 14). Alarmed, the mother sent for a surgeon, Nathaniel Highmore, who prescribed cathartic pills to help him with evacuations. Two days later, Lane died, and Highmore asked for permission to dissect the body, which was granted. Upon dissection, Highmore found a "tumor," and when he opened it up, he discovered what appeared to be a fetus. Highmore and other experts first thought that Thomas was actually a girl who had a monstrous pregnancy, but, after careful examination by multiple experts, he was determined to be a normal male. Highmore then suggests that Mrs. Lane had had a double conception, with one fetus developing properly into her son and the other accidentally attaching itself within his abdomen.

It is the process by which he arrives at his conclusion that is significant, as well as the fact that Highmore publishes this case "by the desire of promoting a spirit of inquiry" (12). He frames science as an open-ended process, whereby facts are continually adjudicated. Moreover, the tensing of an undeveloped imagination against a more disciplined one allows judgment and progress to be revealed. Be-

fore objectivity is enshrined, then, the continuous disciplining of imagination allows the scientist to display his or her epistemic virtue of judgment at work. Highmore underscores his judgment by insisting that the matter is not firmly settled, and its conclusions are still subject to further evidence. Highmore writes, "I shall not enumerate the different theories which fancy has suggested: but to imagine it to have been the fruits of an unnatural crime; or an impregnated ovum, getting from the liquor amnii into the intestine, would require an assumption of so many material facts, not proved,[27] that it seems unnecessary to enter into the discussion" (30). Having dismissed wild unproven fancies, Highmore suggests viewing it in light of an extrauterine fetus: "By some accident, which it is not very difficult to imagine, the impregnated ova got connected together, the one forming an attachment to the uterus of the mother, and the other, (the foetus in question,) to its twin brother; if, I say, this view of the subject be taken, there seems nothing in the matter which is wholly at variance with the known laws respecting generation" (30). Highmore concludes by distinguishing dissection, the "only means of elucidating the real nature of such cases," from the "operation of mere conjecture" (30). He suggests that good explanations should not be too difficult to imagine. He implies that if the imagination is working too hard to present a picture, then it is not to be trusted. The corollary is that normally the imagination works rationally to offer images and trains of association that conform to natural laws. Earlier, he wrote, about the position of the fetus, "It would be difficult to imagine, contrary to the influence of gravity, that as the fetus grew it should ascend" (29). The conjectures of imagination should, moreover, be supported whenever possible by evidence from dissection. His very last sentence warns that, without dissection, so much is "left to the operation of mere conjecture" (50). Perhaps his use of "operation" interjects a bit of irony: Highmore is, after all, a surgeon. In any event, the imagination needs evidence to corroborate it.

Although Alan Bewell studies midwifery manuals in terms of how they limited the female imagination to mimesis, many obstetric authors during the period sought to deny women's imagination even that much power. We have already seen Thomas Young strip the female imagination of any powers to stamp the fetus. James Hamilton, for instance, insisted that "the maternal imagination can possess no power whatsoever over the fetus," and he argued that if mothers actually had this power, "it would be subversive of all moral ties of society" (122). He continues, "We can explain the appearances of unsightly children upon more rational principles," especially the fact that "the parts of the foetus . . . depend on accretion for the growth of their parts" (123). "Women's imagination cannot act on the foetus,"

Hamilton concludes, "because it is not connected with the nervous parts of the mother nor of any vessels" (123).

These refutations of the powers of the mother's imagination function at several levels. One, the denial of these powers consolidates the male scientist's authority and the superior power of rationalism over imagination. Obstetrician Alexander Hamilton warned, "There are no nerves in the placenta . . . hence few are now so credulous to imagine, whatever fabulous stories have been related to the contrary" (*Treatise* 107). Two, the power of the female imagination to make monsters is replaced by the more generally accepted idea of the imagination's influence over the physical body. Here is the entry from *Rees's Cyclopedia*: "We may be convinced of the error of ascribing the actual changes of structure, which constitute the deformities and monstrosities of infants, to the imagination of the mother; . . . yet we have the most satisfactory evidence of the powerful influence of this faculty over the nervous and vascular system, and of the effects resulting from this influence." One might explain this shift by the fact that male midwives had to increasingly show their abilities to empathize with their wealthy female patients (Cody 146–47), and thus scapegoating the mother's imagination was not wise. William Hunter, after all, charged ten guineas per visit! The challenge then became to harness the mother's imagination so as to not make an already difficult labor worse. When refuting the powers of a mother's imaginative longings to imprint themselves upon the fetus, Thomas Denman asks, "Was it thought necessary to adopt and to support the opinion of the power of the imagination, in order to secure pregnant women that tenderness of treatment which their situation requires?" (282). Although rationality certainly tempered the offerings of imagination, it could not explain the imagination's psychosomatic powers, though it could try to manage them.

If Shelley is to critique in fiction the relation of the gendered imagination to science, she perforce has to engage the two major manifestations of this relation in British scientific culture: the male midwives and the embryologists. Let me now turn to embryology, because its practitioners had to figure out what to do with the imagination. Experimental embryologists like Spallanzani chopped up animals, especially lizards and their tails, to study regeneration, in hopes that the regeneration of such appendages would tell them something useful about the process of generation. Victor's decision to chop up body parts and sew them together is perhaps an oblique reference to these efforts.[28] In May 1815, Shelley began a new journal "with our regeneration" (*Journals* 79), which ostensibly referred to the starting of a new household without Claire Clairmont, but successful regeneration would require more than her exile.

VON BAER AND THE MAMMALIAN EGG

In 1831, Shelley remarks in her new preface that "everything must have a beginning. Invention . . . cannot bring into being the substance itself" (195). She continues, "In all matters of discovery and invention, even those that appertain to the imagination, we are continually reminded of the story of Columbus and his egg" (ibid.). When confronted with the charge that anyone could have discovered the Indies, Columbus allegedly challenged his audience to stand an egg on its end. When all failed, Columbus smashed the end of the egg and successfully answered his own challenge. Although this is ostensibly a story of creativity, might this egg obliquely allude to the literal 1827 discovery of the mammalian egg, especially since the death of so many mothers in the novel erases beginnings, and the egg is the substance that brings into being the fetus?[29] Recounting this important discovery, Karl Ernst von Baer described the first time he saw "a small yellow spot in a little sac" ("Ovum" 120), which he initially thought quite "strange." After putting it under a microscope, he recognized "a minuscule and well developed yellow sphere of yolk" in a bitch. Von Baer writes, "Before I found courage to look at it a second time, I had to recover, since I was afraid of having been deluded by a phantom" (*Autobiography* 218). In the original German, von Baer wrote, "Ein Phantom habe mich betrogen," and his reflexive verb underscores his own self-deception. *Betrogen* means "to be duped." His syntax, which places the object of the sentence in the place where the subject belongs, further renders himself passive. He added, "Is it not strange that a sign which is expected, and indeed hoped for, should be frightening when it eventually materializes?" (ibid.). As did Smellie, von Baer shows his eye has learned from practiced passive observation, and his prompt to improve his powers of seeing stem from his wariness of imagination. Moreover, his frank admission of his emotions—his fear of being deluded by confirmation bias—prompts a skeptical testing of his initial observation that gives us a sense of confirmation. Thinking about his finding as a "phantom" of his imagination prompts him better to ground and defend his observations.

Von Baer's published paper announcing his scientific discovery was more muted. He comments, "Led on more by inquisitiveness than by the hope of seeing the ovules in the ovaries with the naked eye through all the coverings of the Graafian vesicles, I opened a vesicle, of which, as I said, I had raised the top with the edge of a scalpel—so clearly did I see it distinguished from the surrounding mucus—and placed it under the microscope. I was astounded when I saw an ovule, already recognized from the tubes, so plainly that a blind man could scarcely deny it" ("Ovum" 132). When he insists that his observations have been

motivated more by inquisitiveness than hope, he staves off an accusation that he is imagining the ovum. Inquisitiveness implies an open mind rather than a fixated imagination, and, by comparison, Victor Frankenstein is once again found wanting as a scientist. Though he does not here cop to his vulnerability to phantoms, von Baer's much more detailed descriptions of observation in the scientific paper better supports the actuality of his finding. Moreover, the fact that he repeats his observations again and again and across different species increases the likelihood that what he sees is not a phantom. Haunted by phantoms, von Baer adduces more and more evidence so that the ovum moves from a theoretical entity to an actuality. With this discovery of the female ovum, von Baer makes the significance of women's material contributions to generation more difficult to deny.

Von Baer praises his teacher Döllinger for his "critical mind and well-controlled imagination" (*Autobiography* 131), perhaps because he recognized that analogies did not just entail similarities. While he thought that development proceeds from lower to higher forms, von Baer demonstrated that there was no exact correspondence between the embryos of higher animals and the adults of lower animals. In fact, he insisted that "those forms in which animality is most highly developed should be furthest removed from the fundamental type" (cited in Gasking 154). Higher organisms did not copy the developmental stages of lower ones. Whereas early embryologists assumed a linear conception of development based on a strictly hierarchical chain of being so that phylogeny straightforwardly recapitulated ontogeny, von Baer stressed different paths of descent based on common archetypes within a class of animals. Imagination here must work spontaneously with observation to know what features of the analogy to push. He also demonstrates control over his imagination when he explains why he does not know which comes first, the mammalian ovule or the Graafian vesicle. He insists, "If one is permitted to substitute a hypothesis for the lack of observations, I believe the ovule precedes" ("Ovum" 137). By consciously turning to hypothesis in the place of observation, von Baer shows he knows the difference between the two and he is aware of the hierarchy of evidence over hypothesis, even as he has no choice here but to run with hypothesis.[30] He adds this excuse: "I have not seen them in the smallest vesicles, but this investigation is impeded by such great difficulties that I have sometimes sought them in vain even in the larger" (ibid.). In his *Entwickelungsgeschichte*, he took care to separate his "Scholia and Corollaries," offering generalizations about development separately from his descriptive observations, perhaps modeling himself on Newton's separation of his calculations and observations from his queries. The distance between them acts formally as a barrier preventing the one from becoming the other.

ERASMUS DARWIN, IMAGINATION, AND STRICTER ANALOGIES

I have thus far argued that within obstetrics gender begins to function as a container for the imagination, not to mention an engine for hierarchy. The female imagination is regarded as something to be disciplined, the display of which licenses the male obstetrician's imagination. If the female imagination was considered entirely subjective, and ignorant of the science of anatomy as well as the technical knowledge of instruments, the delayed discovery of the female ovum made it easier to minimize the significance of women's contributions to generation, a minimization whose consequences Shelley underscores with the death of each mother. Yet the imagination was immune to strict protocols of method, in part because organicism gave it its own purpose. Von Baer's solution was to display his powers of observations triumphing over a feminized imagination. As we shall see, Erasmus Darwin considered the degree to which the imagination's ability to suggest comparisons would help. And yet if he thought that "stricter analogies" in science would solve the problem of how to discipline the imagination, what counted as stricter had first to be imagined.

Mary Shelley's 1831 preface to the novel alludes specifically to Erasmus Darwin and his preservation of a piece of vermicelli that somehow began to move. This allusion once again correlates males with being responsible for life, as it is likened to a spermatic worm. Darwin had written in the advertisement to *The Botanic Garden* that his goal was "to enlist Imagination under the banner of science; and to lead her votaries from the looser analogies which dress out the imagery of poetry, to the stricter ones which form the ratiocination of philosophy." Erasmus was Charles Darwin's grandfather. "Science" here is a branch of knowledge akin to natural philosophy, and Darwin's sense of the way to get there is to harness the imagination's powers of comparison and association, but to apply those comparisons according to stricter standards of ratiocination, which meant that one had to be careful not to assume that a resemblance signified identity. This was ostensibly to work against such occult ways of knowing as interpolating the organization of the body's interior by analogy to the cosmos. Right away we can see that analogy proffers common ground for literature and science; both require the imagination's capacity for figurative forms like "analogy" to make things intelligible, and intelligibility often required an empirical narrative. With regard to generation, analogy provided one of its main tools, since the process had to be observed across a range of living things.

Darwin's own criterion of strictness could not be determined in advance because analogy requires a deft handling of similarity and difference. Methods to

combat a problem can happen only once the problem has been identified, and thus anything approaching a monolithic scientific method is an idealism. Hence, there could be no one protocol for analogy, and it was the operationalization of his criterion for strictness that could be helpful to science. In his *Observations on Man*, David Hartley had insisted, "In science analogy leads on perpetually to new propositions; and being itself some presumption of truth, is a guide much preferable to mere imagination," but Darwin was warier of what such presumption might do to science. And yet, since the indiscriminate use of analogy hardly redounds to the credit of art, what we are dealing with are differing ways of measuring and operationalizing strictness. To claim that science uses analogies more strictly, then, is to ignore the kinds of precision that art requires with analogies, such as a building up to unity.

To get to the unknown, Darwin relies on arguments via analogy to the known: the "embryon is secreted or produced by the male, and not by the conjunction of fluids from both the male and female appears from the analogy of vegetable seeds" (Z 1: 489). In turning to vegetables to think about animal generation, Darwin relies upon what he considers a strong analogy between animals and plants, both being animated beings. In this instance, "stricter" invokes larger principles. Haller had warned that the signal cause of error within physiology was that "physicians have made use of few experiments, or even none at all, but have substituted analogy instead of experiments" (cited in Roe 92). Under "experiment" he included observation, and, since those observations were to confirm or to consider the probability of rational arguments, the validity of the analogy could be confirmed by appropriate observations. This may be why Darwin, however, stresses the verb "appears," which reminds readers that analogies hang on appearances, but those appearances may offer similarities that turn out to be deceptive. One way to move the appearance more firmly into the camp of knowledge is to consider the extent to which the analogy represents a natural law. As I will show below, Darwin faults Buffon's concept of interior molds in part because Buffon neglected natural laws. By contrast, Darwin offers a range of examples from different species, suggesting that the male secretion or production of the embryon is a law. When Shelley makes Victor Frankenstein the monster's sole parent, she draws upon a history of arguments going back to Aristotle and forward to Darwin within the study of obstetrics and generation that credit the male with producing the stuff that truly matters, if only to register her skepticism and explore the consequences of such patriarchal fantasies such as Victor's imagining of the creature's obeisance.

Early on in his chapter on generation, Darwin offers key clues to how he understands the limits of analogy. He writes, "Thus the uterus during pregnancy is

greatly enlarged in thickness and solidity as well as in capacity, and hence must have acquired this additional size by accretion of new parts, not by an extension of old ones; the familiar act of blowing up the bladder of animals recently slaughtered has led our imaginations to apply this idea of distention to the increase of size from natural growth; which however must be owing to the apposition of new parts; as is evinced from the increase of weight along with the increase of dimension" (Z 1:495). The analogy of generation to the inflated bladder assumes a similarity based on mere appearance and thereby allows the imagination to usurp reason and the mind that would contain it. While the analogy accounts for an increase in size, it cannot account for an increase in weight. One takeaway: beware of superficial comparisons, and know how to check whether the comparison is merely a surface one. The rise of morphology complicated matters with the argument that, in the words of von Baer, "all the differences of any organ whatsoever . . . exist within the limits of strong similarity" ("Ovum" 142), thus taking issues of function off the table and by grouping objects of study by their similarities of form and structure.[31]

Darwin's concept of "intuitive analogy" also helps to chart a course of further development even as it recognizes the value of intuition. Science is thereby again modeled on organic process. He writes, "In our waking hours whenever an idea of imagination occurs, which is incongruous to our former experience, we feel another kind of surprise, and instantly dissever the train of imagination by the power of volition, and compare the incongruous idea with our previous knowledge of nature, and reject it by an act of reasoning, of which we are unconscious, termed in *Zoonomia*, intuitive analogy" (*TN* 214). Here, surprise interrupts the train of associations and opens the door for volition to enter the picture. Did this feeling of incongruity equate to ratiocination? Nonetheless, the path forward is tricky because, although Darwin aligns intuition with reasoning, he also aligns it with the unconscious. The question is, can reason become more conscious of its analogies, and if so, how? Without conscious awareness, it was difficult to see how the imagination might chart a clear course of progress. And yet the absence of conscious awareness meant that invention was not beholden to any single framework, enabling thinking outside of the box, but only perhaps because one was unconscious of the box.[32] Darwin's insistence upon ratiocination thus demands that analogy be continually subjected to validation, especially since new knowledge might render a previously useful analogy moribund.

Darwin develops what he means by "stricter analogies" when he discusses his theory of monsters. Here, his primary concern is that the theory conform to intelligibility and logic. One of the dangers of intelligibility as a criterion for natural

science, however, is that the intelligibility provided by cultural assumptions about gender and sex might outweigh scientific evidence. Darwin argues that monstrosity is largely a disease involving nutrition, and although he does not come right out and blame women for monstrosity, the fact that he thinks women are responsible for nutrition of the child means that they are.[33] Crucially, Shelley portrays Victor's generative ambitions during the creature's construction as masculine desires for glory, not feminine anxieties about childbirth.

Buffon's theory of *moules intérieur*, translated as "interior molds," which Buffon introduced in his *Histoire Naturelle* in 1749, further allows Darwin to figure out what he means by "stricter." Mary Shelley records having read *Histoire Naturelle* in June and July 1817 (*Journals* 174–75). Charles Bonnet had in 1762 argued that "philosophically having understood the impossibility of explaining mechanically the Formation of Organized Beings, it imagined, happily, [a imaginé heureusement] that they existed already in small dimensions, under the form of germs or organic corpuscles. That idea produced two hypotheses, which greatly pleased reason" (*Considerations* 1: 1).[34] Two points. One, the goal is philosophical understanding. Two, the imagined analogy prompts two hypotheses. Buffon ascribed the agency of this *moule* to "penetrating forces" that were based on an analogy to gravity and magnetic attraction. Buffon had turned to this plastic living organic power to try to explain both the basis of reproduction and the power behind the development of the embryo. And yet what irked Darwin most was Buffon's claim to have found an analogy that would in its ability to generate more analogies conform more to truth. Buffon had written, "Elle deviendra d'autant plus vraisemblable que le nombre des analogies sera plus grand, & pour nous faire mieux entendres" (2: 37). As the number of analogies increased based on this original analogy, Buffon thought it would allow us better to hear nature. This generativeness of Buffon's analogy flew in the face of Darwin's desired strictness. Furthermore, Buffon had deliberately chosen a strange term because the idea of contradiction that it might present through its very novelty could interrupt trains of thought.[35] Here, figurative language startles the mind into attention. Darwin concentrated his objections to Buffon on how these entities seemed simultaneously mechanical and vital, and therefore did not make sense: "Mr Buffon has with great ingenuity imagined the existence of certain organic particles, which are supposed to be partly alive, and partly mechanic springs . . . These organic particles he supposes to exist in the spermatic fluid of both sexes, and that they are derived thither from every part of the body, and must therefore resemble, as he supposes, the parts from whence they are derived" (Z 1: 495). Darwin is so concerned to place Buffon at arm's length that he thrice insists upon the great naturalist's sup-

positions, implying that there is no actual basis for them. His imagination wantonly builds castles in the air, much in the same way that Shelley describes the pleasures of her following the imaginative dreams of her girlhood (1831 preface 194) so that she can show herself as having outgrown them. "Stricter application" then does not rely expediently upon convenient suppositions, and certainly it would hardly pile supposition upon supposition. Moreover, from Darwin's perspective, the analogy of interior forces to gravity cannot provide an ontology for Buffon's penetrating forces.

Darwin elaborates: "Many objections might be adduced to this fanciful theory, I shall only mention two. First, that it is analogous to no known animal laws. And secondly, that as these fluids, replete with organic particles derived from the male and female organs, are supposed to be similar; there is no reason why the mother should not produce a female embryon without the assistance of the male, and realize the *Lucina sine concubitu*" (Z 1: 496). Although Darwin here associates the imagination with "ingenuity," that initial praise slides into blame as Buffon's idea becomes a "fanciful theory." By implication, fancy so undermines the claim that Darwin can be bothered to muster only two of the many arguments he could against it. Perhaps this is also because the ease of ingenuity rubs against the hard work of collecting data and pursuing confirmations. The man of science comes into being with practices of observation that count as labor, and the mere suggestion of being ruled by "fancy" cancels out that image. In any event, Darwin applies his distinction between strict and loose analogies, using the absence of a natural law as a key criterion. Darwin's second problem with Buffon's idea is that it provides two possible causes for generation, when, strictly speaking, only one is necessary. More upsetting is the fact that Buffon's *moules* make it possible for women to compete with men as the cause of generation; two causes violate the rule of explanatory parsimony: one should never generate more explanations than are absolutely necessary.

JOHN HILL AND IMAGINARY PROJECTORS

Darwin's earlier allusion to *Lucina sine concubitu* is deliberately provocative and hints at the much larger stakes behind the imagination and a complex genealogy behind strict analogies.[36] The phrase refers to a satire written by John Hill to the members of the Royal Society upon his rejection for admission to it. Lucina is a mythological goddess who conceives without a man, and Hill here recalls Joseph Tuberville Needham's dismissal of preformationism on the grounds that the newborn cannot possibly spring from eggs in which the newborn is fully formed (G. Rousseau, *Notorious Hill* 67). Hill had published a number of important and

respected botanical studies and an analysis of fossils, along with a study of the nerves, all of which the great Albrecht von Haller had deemed important enough to have read. Many members of the Royal Society had published significantly less. Yet, according to his biographer, Hill's prickly and ambitious personality doomed his candidacy. Hill would later become the first person to name tobacco as a cause of cancer (G. Rousseau, *Letters* ix). In his letter, Hill poses as a midwife and argues that immaculate conception was possible because male animaculae were everywhere, blown by the wind. This theory is known as panspermism. Twice, Hill praises naturalists for their reliance upon "the great Analogy and Similitude in the Generation of all animals" (*Lucina* 12). Anticipating Darwin, Hill complains of the "looseness of poetic description" (24). Finally, he chides those who, in their ignorance of real causes, "assign imaginary ones" (25), as if floating embryos weren't imaginary. Behind Darwin's call for stricter analogies is Hill's mocking letter.

Hill's parody of the Royal Society's methods was disturbing: he used the scientific language of the Royal Society against itself to lend credibility to his work. Hill thus refuses to rely on the authority of great names (*Lucina* 12), cites articles in the Royal Society's *Philosophical Transactions*, offers "light and confirmation of [his] hypothesis" (24), and chides Newton for indulging in speculation, while he claims to have extended his ideas into "practice" (20). Hill further explicitly instrumentalizes his findings. Historian of science Peter Dear has called attention to how "science" turned to instrumentality during this period as one of its defining goals. Immaculate conception does away not only with venereal disease but with the invention of his machine to catch the airborne embryos; Hill obviates male sterility along with the need for marriage itself. When Hill describes the airborne animalcule under the glass, his language recalls those skeptical of Leeuwenhoek's microscopic observations: "Oftentimes, when I was viewing them through my glass, my Imagination would turn Romantic and represent to me the great variety of fortune they go through" (13). As historian Lisa Cody argues, microscopists like Leeuwenhoek were accused of misusing their imagination (113) when they analogized animalcules into beings.

Hill's letter, thus, serves as an intriguing counterpoint to *Frankenstein*, as its opening premise is the novel's precise opposite. If the novel considers what happens when men give birth, Hill argues that women don't need men in order to conceive. Hill further invents a machine to catch these floating embryos, which he had "electrified according to the nicest laws of electricity" (*Lucina* 13), and thereby brought them to life. Is this what inspires Shelley to use the battery to "birth" the monster? Both texts dwell on role of analogy and imagination. Hill takes for granted the "great Analogy and Similitude in the generation of all ani-

mals" (11). Hill highlights the imagination's tendency to romanticize, and Shelley agrees. And if Victor relies too much on his imagination, Hill's protagonist finds a passage in the work of someone else that strikes his imagination so forcefully that he simply appropriates this work as the "foundation and groundwork" of his own system (7). Hill also warns of the dangers of too strict analogies: the imagination might become too constricted. In his review of the Royal Society's *Philosophical Transactions*, Hill quotes from the *Tatler*: "There is no study more becoming a rational creature, than Natural Philosophy; but as several of our modern Virtuoso's manage it, their speculations do not so much tend to open and enlarge the mind, as to contract and fix it on trifles" (viii). Perhaps it is telling that Hill's midwife persona makes decisions with more self-awareness than Victor Frankenstein can muster. Shelley further echoes Hill when she claims Clerval's imagination "was too vivid for the minutiae of science" (49), and when Victor declares his distaste for modern natural philosophy on the grounds that "the ambition of the enquirer seemed to limit itself to the annihilation of those visions on which my interest in science was chiefly founded" (29). Not only does Hill remind us of how much science was finding its way during this period—it was far more fluid than we tend to assume—but he also shows how easily science could look like fiction and vice versa. However, to base one's interest in science on visions is beyond the pale.

Even more to the point, both Hill and Victor also protest too much that they are not projectors, Jonathan Swift's version of Royal Society scientists who devote their lives to useless projects. Hill's protagonist asks to be "redeemed from the reproachful name of projector" (*Lucina* 25); likewise, Victor claims, "I could not rank myself with the herd of common projectors" (180). Like Swift's projectors, who waste their time converting shit into food and harvesting sunshine from cucumbers, Victor spends his time creating a monster and then running away from its consequences. And like those projectors who think themselves useful, Victor trumpets his "daily usefulness, without which no man is fit for society" (70), even as the dead bodies pile up all around him. Shelley's point is that at least Swift's projectors cause no direct harm. In sum, Hill's work and its ambiguous status between science and parody threw the gauntlet down to the Royal Society to do more to help distinguish between science and fiction. Hill is important to *Frankenstein* because he calls into question the powers of science to deliver modernity and reminds us of the costs of science's proximity to literature, not always to the benefit of either.

Nonetheless, this proximity could offer substantial resources. In his pursuit of stricter analogies, Darwin misses the point of Buffon's deliberate paradox. Buffon argued that "moules intérieur" joins two terms that appear contradictory: "parois-

sent contradictoires" (*Histoire Naturelle* 2: 36). One, the idea of form, applied only to surfaces. The other, inner, was usually applied to mass (Reill 47).[37] Hans Peter Reill argues that for Buffon "a language of nature must be able to capture [nature's] opposing, merging and balancing forces, without destroying any of them linguistically by reducing them to a false unity" (47). To get at organicism, then, Buffon resorts to a paradox that calls into question whether the strictness of analogy is even desirable. Paradox relies upon a dialectical force between opposites that questions how much precision is possible. Moreover, since Buffon believed that natural history was about discerning relations between entities, and not causes or essences, analogy for him bespoke the language of nature (Reill 52). For Buffon, analogy is evidence, not method. The upshot here is that, where Darwin wanted analogy to foster ratiocination and limited strictness to that idea of it, Buffon was interested in how the formal properties of analogy actively performed the organic powers that could not be otherwise named. Buffon's generative analogies thus sought to take advantage of the aesthetic properties of language for the benefit of biological science. Only those aesthetic properties could capture the idea of structures in formation.

Like Buffon, Victor Frankenstein repeatedly separates external form and interiority, but, whereas Buffon had a larger point to make, Victor's use of the concept remains at the level of contradiction without his knowing so. Victor, of course, praises Buffon, "read[ing] him with delight" (25). He repeatedly claims a distinction between form and being, but offers no coherent rationale for the split. He refers to the monster as "a being whom I myself had formed, and endued with life" (57). Yet can one be considered a being without life, and if so, what does it mean to have formed a being? Since he has combined the parts of a dead being, Shelley further chalks up his inflated sense of his own contributions to the needs of his masculine ego. If Buffon's *moule intérieur* points to a performative active organic synthesis between morphology and interiority, Victor's terms amount to a juxtaposition of opposites that don't quite make sense. Fittingly, the monster has an exteriority that he cannot reconcile with his interiority: he is a walking *moule intérieur*, but one whose parts don't add up to an organic whole, and how could they? They were dead.

However, no sooner than Darwin upbraids Buffon does he venture his own speculations, and any clear path forward toward stricter analogies seems in jeopardy: "I conceive the primordium, or rudiment of the embryon, as secreted from the blood of the parent, to consist of a simple living filament as a muscular fibre; which I suppose to be an extremity of a nerve of locomotion, as a fibre of the retina is an extremity of a nerve of sensation; I suppose the living filament, of whatever

form it may be, whether sphere, cube, or cylinder, to be endued with the capability of being excited into action by certain kinds of stimulus" (Z 1: 496).[38] Darwin offers two leads. One, he frames his analogies as similes and thus reminds us of their figurative status. Second, he makes explicit the basis of his analogy so that the strictness of its comparison of a rudiment to a muscular fiber can be evaluated. His physiology nonetheless relies upon blood being the source of the rudiment. Once again, the imagination's ability to generate analogies cannot be dispensed with, but how, and on what terms, could what was generated be trusted? In sum, because larger philosophical positions could always be brought in to justify the choice of analogy, the best one could do would be to, on the one hand, be extremely modest in one's use of them and, on the other hand, offer examples of consilience that make clear the analogy is not just about surface similarities.

Mary Shelley's own attending obstetrician in 1815, Charles Clarke, worried about how the field's overreliance upon imagined conjectures—he called it "hypothetical reasoning" (1)—and mistaken analogies.[39] To counter these, he came up with his own taxonomy of diseases associated with discharges of the female organs of generation, precisely because obstetricians had in his view mistakenly lumped women's diseases together under their unifying symptoms, which were only superficial similarities. Clarke urged further that these diseases be named according to their underlying causes and not their common symptoms so that diseases could be grouped under their proper treatments. Once again analogy threatens to find the superficial similarities or symptoms instead of the deeper underlying causes. For Clarke, analogies among symptoms threaten the very possibility of a useful nosology.

Darwin's and Clarke's calls for the imagination to use stricter analogies shapes Shelley's understanding of the relation of life to electricity. While electricity offers a possible analogy to life, analogy does not mean identity. Their friend and surgeon William Lawrence had insisted that "there was no analogy between electricity and life: the two orders of phenomena are completely distinct" (*Introduction* 170). Any similarity, he claimed, "is only in appearance" (171). To highlight her skepticism of the analogy, Shelley does three things. One, she frames the relation of galvanism to life as a "token" of identity. In her 1831 preface, Shelley argues, "Perhaps a corpse would be reanimated; galvanism had given a token of such things" (195). Two, she considers the fact that Victor, an alleged expert on generation, does not seem to have a sense of the difference between life itself and the appearance of life.[40] Hence, he thanks Clerval for restoring him to life when all he did was restore his signs of life. Likewise, he thanks Walton for having "benevolently restored me to life" (14), while Clerval's letter later "recalled me to life"

(142). Without a distinction between life and signs of life, or between life and its symptoms, all Victor can do is to put together superficial analogies, analogies that speak only to the surfaces or symptoms of things that can come to life only in fiction. Third, even the monster knows better than to conflate signs of life with life. He describes his rescue of a drowning girl thusly: "She was senseless; and I endeavoured, by every means in my power, to restore animation" (115). His terms are "senseless," which makes sense, and "animation," both of which indicate signs of life rather than life itself. Victor, after all, takes for granted that "to examine the causes of life, we must first have recourse to death" (33), but how could the study of life's opposite show its causes? Mary Shelley indirectly questions whether there is an analogy of life to death or whether those are fundamentally different categories.[41] Percy owned Gregory's *The Economy of Nature*, and, in a section labelled "Analogy between this Influence [Galvanism] and Electricity," Gregory noted similarities and differences between the two, claiming "animal electricity is produced by two metals, which are both conductors" (1: 379). If animal electricity is produced by two metals, then there is nothing "animal" about it. He explains further that galvanism is not "nervous energy" because it is not stopped by cutting the nerve or a tight ligature (1: 381).

VICTOR FRANKENSTEIN AS IMAGINATIVE SCIENTIST

I have shown how the man-midwife actively feminized the imagination as a faculty to be mistrusted so that it can be manipulated and placed under masculine authority.[42] Even better: making the female imagination the root of error took off the table any mistakes the man-midwife might have made with his instruments in the assistance of delivery. Early on in the eighteenth century, the belief in women's imaginations as being responsible for monsters facilitated reading blemishes and injuries from overuse of instruments like the forceps as the mother's fault.[43] The monster adopts the idiom of the male midwife when he tries to "assist the labours" of the peasants, but one question was, did those labors require assistance? (88). And, in fact, the peasants were doing okay before he appeared. Shelley's treatment of Victor's imagination shows that masculinity will not inoculate it. Because the imagination was embodied—Victor's scientific efforts always lead to his nervous exhaustion—science relies upon an imagination that cannot provide the autonomy and mastery it is sometimes accused of having. As Shelley knew, development is not just an effect of the passage of time, and the mind was not autonomous from the body (Yousef). Yet, because it is subject to the contingencies of bodily experience, the imagination has every potential to grow from social interactions. Unfortunately, Victor Frankenstein repeatedly allows his imagination to control

him and does not recognize that, without a subject capable of disciplining the imagination, he could not hope to make valuable contributions to science or to society. If the comparison of the imagination to generation suggested it was organic, and thus subject to processes of development and growth—Darwin insisted it guided the development of the embryo, thus increasingly the stakes of its development—Victor's imagination is arrested, isolated, and diseased. His hard work "deprives him of rest and health" (39), and he must be revived by the care of others. His exhaustion of his imagination aligns it with disease as opposed to health, and this is one of Shelley's strongest arguments against Victor. Indeed, his imagination is diseased by nostalgia, which Shelley refers to as his "maladie du pays."

Shelley recognizes that big breakthroughs require the leaps of imagination, and thus she shows that dreams, because they are freed from the obligation to mirror reality, can lend important insights. In his first dream after the monster comes to life, for instance, Victor kisses his future wife, Elizabeth, only to have her instantly perish (39). What he subconsciously recognizes is that he will be responsible for her death. Likewise, Darwin thought that analogies originated in unconscious intuition, but their scientific value needed to be tested by ratiocination, if not by observation and experiment. When it becomes regularized by habit, however, its ability to offer anything radically innovative can be lost. The author of the entry on imagination in *Rees's Cyclopedia* framed this worry thusly: "It is highly probable, that whatever is regular and rational in a train of thought, which presents itself spontaneously to a man's fancy, without any study, is a copy of what had been before composed, by his own rational powers, or those of some other person." To the extent that conscious thought modeled itself on previous thought, it threatened merely to reproduce what was already known or copy previously held thoughts.

Shelley acknowledges the stakes and challenges of being able to control the imagination clearly when she has Elizabeth weigh the influence of reason against imagination just after the death of Justine.[44] She has Elizabeth comment, "Before, I looked upon the accounts of vice and injustice, that I read in books or heard from others, as tales of ancient days, or imaginary evils; at least they were remote, and more familiar to reason than to the imagination; but now misery has come home, and men appear to me as monsters thirsting for each other's blood" (71). When vice and injustice were just theoretical and abstract entities, they were familiar to her reason. But, after "misery has come home," imagination takes over and grants evils a vividness and immediacy that prompts her to see humankind as "monsters thirsting for each other's blood." This tendency to believe the vividness of the imagination's images can have devastatingly unjust effects. Justine's jurors, for in-

stance, neglect all testimony regarding Justine's kindness, "by the imagination of the enormity she was supposed to have committed" (61). And yet, unlike Victor, Elizabeth reflects upon the difference between imagination and reason, and her use of "appears" indicates that she knows what her imagination has told her is an exaggeration. Shelley thereby challenges the version of the female imagination men-midwives offered by having Elizabeth have a kind of control over her imagination that Victor does not.

Like the man-midwife's version of pregnant women, Victor's problem is that his imagination is a virtual homunculus that takes the place of his subjectivity.[45] He repeatedly delegates sovereignty over his imagination to many others: "Agrippa, Magnus, and Paracelsus, who had for so long reigned the lords of [his] imagination" (25). And, once "warmed," his imagination acquires an agency of its own and does not turn back. Despite the fact that he recognizes that these writers indulge in "wild fancies" (23), he uses no caution. Even after his experiences with the monster, Victor blames his father for not having explained why Agrippa had been superseded. Indeed, he argues, "It is even possible, that the train of my ideas would never have received the fatal impulse that led to my ruin" (23). Here, Shelley exploits Darwin's linking of imagination to the building of trains of association, and, by reading the catalyst to these trains as "fatal," he takes no responsibility for them. More importantly, he views his own mind as an automated machine: by assigning a fatal impulse that starts the train of thought and continues it to its end, Victor does not have to think about his own role in his thoughts. His flirtation with the third person when speaking of his imagination is also telling, and this allows the homunculus of Victor's imagination to be seen as a kind of rhetorical double to the male midwife's offloading of ethical responsibility onto the maternal imagination. Victor claims, "My imagination was too much exalted by my first success to permit me to doubt of my ability to give life to an animal as complex and wonderful as man" (35). He adds, "My imagination was busy in scenes of evil and despair" (57), as if it is doing things all on its own. Shelley here begs the meaning of the pronoun "my." Later, after he destroys the female monster, Victor comments that "my imagination conjured up a thousand images to torment and sting me" (141). Although the imagination's powers to conjure images was widely accepted in sleep during dreams, Victor is here wide awake and does not even recognize the absence of his will as a problem.[46]

When Walton's crew is about to be crushed by ice, Victor tries to goad them into persevering: "Now behold, with the first imagination of danger, or, if you will, the first mighty and terrific trial of your courage, you shrink away" (183). Victor's ability to equivocate "imagination" and "trial"—he pivots these terms around an

"or"—underscores the untrustworthiness of his imagination. Victor later proudly declares that his situation was "one in which all voluntary thought was swallowed up and lost" (170). Displaced from this sentence is Victor's own personhood, and it has been replaced by a "situation" that usurps the place of the subject. All of these substitutions allow Victor to find himself blameless, as he does. Another worry about his inflated imagination: when it is too exalted, the imagination becomes incapable of doubt, and science is impossible without it. Once again his imagination usurps his personhood. His monster follows suit. Referring to revenge, the monster states, "I think on the heart in which the imagination of it was conceived" (190). My immediate point here is that the monster turns to his heart as a surrogate for the self and imagination, but should the heart be the locus of the imagination, and in what sense is a heart capable of conception? This is potentially a throwback to Haller, who thought the heart was the center of proper internal organization, not the brain. Unlike the case of Thomas Lane, where even the extraordinary circumstance of a male having a fetus within him did not do away with the need to impose known laws, neither Victor nor the monster feels any such compulsion.

When he does try to connect his observations with laws, Victor indulges in complete absurdity: "Alas!" he exclaims. "Why does man boast of sensibilities superior to those apparent in the brute; it renders them more necessary beings. If our impulses were confined to hunger, thirst, and desire, we might be nearly free; but now we are moved by every wind that blows" (75). What Victor sees as freedom would amount to its direct opposite: a compete indebtedness to necessity. Also, having feelings does not mandate being completely controlled by them, but, characteristically, Victor equates having feelings with complete indulgence in them.

Once we see that Victor repeatedly gives over anything like personhood to his imagination and emotions, we are better positioned to evaluate his scientific choices. For one, he simply assumes that life is a principle, as if there were no debate about what relying upon a metaphysics means for science. Shelley shows her contempt for this by reminding readers of alchemy's misguided search for the "elixir of life" (30), but what made the search for vitality as a principle different? Although Victor denies that he is a projector, Shelley does not agree, insofar as merely being useless would be an improvement over the devastation that Victor causes. To develop its powers so that the imagination can be productive for science and art, judgment is required. Unsurprisingly, the only judgment Victor has exercised has occurred in the past tense: "When younger . . . I possessed a coolness of judgment that fitted me for illustrious achievements" (179). The fact that he sees himself like Satan "chained in an eternal hell" shows his complete loss of judgment, as

he fails to recognize Milton's irony. He also does not see the irony in his claim that "in a fit of enthusiastic madness I created a rational creature" (185). If he was in such a fit, how could he know what was rational, let alone create a rational creature? And if to be rational is to think for oneself, is it possible to create a rational creature at all? In his rush to pat himself on the back, Victor neglects the fact that rationality must be developed. The fact that Victor blacks out, overcome by events at several critical points in the novel, only further undermines his scientific pretensions, as does the fact that he never once misses his laboratory notes, from which the monster gleans his origins.

Because of his passive reliance upon his imagination, Victor Frankenstein makes for a poor scientist. Although many have read the novel as an indictment of male science—most famously Anne Mellor—comparing Victor to the scientists of his time puts the blame where it properly belongs: at the doorstep of Victor's undisciplined imagination. When he fantasizes about the adulation he will receive—"no father could claim the gratitude of his child so completely as I should deserve theirs" (36)—Victor mistakenly categorizes his imagination as his "reflection" (36). By implication then, the problem is not so much science itself but rather how to do better science. Because his imagination has no corrective, he adopts outdated and superseded models like alchemy and magic, and mistakes narcissism for autonomy. As a result, he cannot even grasp the significance of such scientific terms as "boron" or "sulphates" or "potassium," because he could "affix no idea" to them (25). Victor ascribes his own blindness to the possibility that the monster had been "possessed of magic powers" (161). As he undergoes the trials of the Arctic, he also "may not doubt that it (his repast) was set there by spirits that I had invoked to aid me" (173). Indeed, he calls upon the spirits of the dead to aid in his plans of vengeance. Very near to his last breath, Victor is startled by the realization that "all my speculations and hopes are as nothing" (180). The problem is that they *are* nothing and thus require some kind of confirmation. Even at this late date Victor tries to stave off the nothingness of speculation with the simile "as."

There is a deeper irony here, given that proponents of the imagination had celebrated its physiological powers over the body as a triumph over the very magic and superstition Victor embraces. The author of the encyclopedia entry on imagination in *Rees's Cyclopedia*, Percy Shelley's eye surgeon, William Lawrence, writes, "in such a state of the human mind, when natural philosophy, meagre as it was, was disguised with the name, and clothed with all the supposed agencies of magic." The author cites the commission on mesmerism, which disproved magical animal magnetism and replaced it with the imagination as explanation. Even worse for Victor, when Mr. Waldman explains the difference between ancient and

modern chemists, he deliberately aligns himself with the ancients over the moderns. The passage is worth close examination: "'The ancient teachers of this science,' said he, 'promised impossibilities, and performed nothing. The modern masters promise very little; they know that metals cannot be transmuted, and that the elixir of life is a chimera. But these philosophers, whose hands seem only made to dabble in dirt, and their eyes to pore over the microscope or crucible, have indeed performed miracles. They penetrate into the recesses of nature, and shew how she works in her hiding places'" (30). With this passage, Shelley underscores that Victor's choice of the ancients over the moderns aligns him with the performance of nothing. Moreover, where Waldman frames close observation and having dirty hands as performing miracles, Victor will regard this work as beneath him and as without ambition. Now Waldman does frame nature as a female body that hides and therefore must be penetrated, and perhaps this explains why Victor departs "highly pleased with the professor" (31).

In addition to magic, alchemy, and spirits, Victor flirts with another theory that no longer made sense: preformationism.[47] Preformationists were by the Romantic period satirized for their ample imaginations: the idea that every single being was already preformed within the ovaries of Eve may now seem preposterous, but, without cell theory, there was no lower limit on organic size (Gould in Pinto-Correia xv). Bonnet countered this by defining the germ as not a fully preformed creature but rather as a loose sum of all the fundamental parts of the future individual (Pinto-Correia 58). He thus made preformationism easier to swallow. Victor forms his monster by sewing together preformed parts. Victor also speaks as if he endorses the idea that form precedes life: he writes, "A being whom I myself had formed, and endued with life, had met me at midnight" (57). Here, form precedes life, but, instead of God having done the preformation, Victor egotistically inserts himself. In contrast, William Lawrence had argued, "Living beings . . . always have a form characterizing the species to which they belong" (*Introduction* 126).

From Lawrence's perspective, the biology of living forms mandated the inextricability of form from life. Shelley's plotline counters Lawrence's materialism by separating animation from structure, and thus Victor pronounces, "Although I possessed the capacity of bestowing animation, yet to prepare a frame for the reception of it . . . still remained work of inconceivable difficulty and labor" (35). Not only are the monster's parts preformed, but their physical growth and development is taken off the table because they are fully formed. When he considers making the female monster, he assumes that form entails predispositions: "I was now about to form another being, of whose dispositions I was alike ignorant" (138). Like the midwife who turns to preformationism to absolve himself of any

defects caused by his instruments, Victor does not recognize the need to parent the monster. And just as preformation hinted that development was the progressive unfolding of a divine plan, Victor sees himself repeatedly as fated. Very early in the novel, Shelley even shows us Victor's imagination at work. She writes, "The picture appeared a vast and dim scene of evil, and I foresaw obscurely that I was destined to become the most wretched of human beings" (55). As soon as the picture appears, Victor believes in it.

In fact, Victor's imagination is what prevents him from doing science that might prove useful. It excuses him from hard work. When Victor first imagines that the monster has killed William, he comments, "No sooner did that idea cross my imagination, than I became convinced of its truth; my teeth chattered . . . The mere presence of the idea was an irresistible proof of the fact" (56). He defines the presence of the idea itself as its proof, and, whatever Shelley thought of the imagination, she did not think thoughts could be their own proof. His imagination does nothing less than short-circuit the very possibility of science and in so doing mistakes his own narcissism for autonomy. Because he sees science as the path to grandeur, he frames its empirical concerns as beneath him and thus deprives science of an other that would challenge it to improve. To wit, he claims that Clerval was "no natural philosopher" on the grounds that "his imagination was too vivid for the minutiae of science" (49). This coming from the man who turned to the parts of an eight-foot giant to make his work easier is rich indeed, suggesting the degree to which Shelley wishes her readers to find him disagreeable. Seeing the experimental work as minutiae makes it difficult to motivate oneself to do it. When coupled with his sense of his thoughts as proof, verificationalism goes out the window, and the problem is that imagination has nothing to rub up against and nothing that will help it correct itself.

Shelley insinuates that Victor's overreliance upon his imagination makes him especially vulnerable to seduction by dogma. Whereas the scientist needs to subject his or her conjectures to some kind of confirmation, dogma provides blanket rules before any contingencies can be considered. Dogma takes all contingencies off the table and offloads the thought process onto preconceived ideas. Indeed, Victor relies on entities like "destiny" so that he does not have to think about the meaning of his actions and choices. Even worse, his susceptibility to dogma not only makes him untrainable, but it also violates any potential benefit of thinking about one's thoughts in terms of organic development, as the comparisons of imagination to generation encourage. In the course of the novel, Victor holds onto the following dogmas: all knowledge is dangerous and therefore should not be sought; change is painful to the human mind, so don't expose it to change. Early on, Victor

tries to convince Walton to "learn from me, if not by my precepts, at least by my example, how dangerous is the acquirement of knowledge" (35). Not only does this premise drain the novel of everything that is of interest, but it also means that Victor's knowledge that all knowledge is dangerous is also dangerous. He does not consider that there might be a gap between knowledge and the use of it. Near the end, Victor pronounces, "Nothing is so painful to the human mind as great and sudden change" (167). All this belief does is encourage insulation from change, as if that were possible. As we might expect, the changes surrounding Victor cause him to "be incapable of any exertion" (167).

Victor's overreliance upon his imagination even distorts how he understands the scientific process. Shelley asks us to see how the analogy of scientific discovery to birth misrepresents how science should work. Victor forgets all the painful labors that precede his discovery, making it seem like it was a miraculous and instantaneous conception. Moreover, the excitement of the discovery was so great that it completely overshadowed the preparatory work to get there. Victor describes the moment thusly: "The astonishment which I had at first experienced on this discovery soon gave place to delight and rapture. After so much time spent in painful labour, to arrive at once at the summit of my desires, was the most gratifying consummation of my toils. But this discovery was so great and overwhelming that all the steps which I had progressively led to it were obliterated, and I beheld only the result" (34). In the same way that men-midwives tended to ascribe all the good that happened to their expertise and intervention, Victor gives himself nothing but accolades and finds himself blameless. Jo-Murphy Lawless comments that "obstetricians tended to see what they had accomplished, exclusive of other factors which lay outside their control" (192). Although the metaphor conflating scientific discovery with birth would seem to highlight process, Victor truncates the process and in fact erases the signs of process and labor. Fittingly, the monster somehow makes off with Victor's laboratory notebook, the only record of that process and labor. All he beholds is the result, and the danger of this foreshortening is that science looks like it has methods that can be known in advance. This version of his discovery contradicts his later claim that he had united the qualities of imagination and application equally (180). Moreover, Victor subscribes completely to the idea that "the labours of men of genius, however erroneously directed, scarcely ever fail in turning to the solid advantage of mankind" (31). This theory of the generative labors of genius provides incentives neither to find nor to learn from error and thus no methodological corrective. And this theory leads to catastrophe. Part of Shelley's solution is thus to insist that theories need testing, and those that originate under the banner of genius need all the more testing. To

the extent that Victor's bringing the monster to life is an experimentum crucis, Shelley argues that such a thing is a myth because no single experiment could resolve the issues involved. Finally, Victor rejects all efforts at falsification on the grounds that they do not satisfy ambition: "The ambition of the inquirer seemed to limit itself to the annihilation of those visions on which my interest in science was chiefly founded" (29–30). Although there was little glory in falsification, that was an important part of science.

There is one small ray of hope, one glimmer that Victor has not entirely lost his judgment. When Victor offers his deposition so that the magistrate will help him pursue the monster, he comments, "It is indeed a tale so strange, that I should fear you would not credit it, were there not something in truth which, however wonderful, forces conviction. The story is too connected to be mistaken for a dream, and I have no motive for falsehood" (169). In the same way that Darwin turns to the strictness of analogy to validate it, Victor insists that the connectedness of his story indexes its truth and that has the power to compel belief. In this rare moment, he provides a standard by which to evaluate the claim. Given that the success of embryology depended upon the ability to identify meaningful patterns within the evidence, having this criterion begins to suggest the possibility of distinguishing between surface similarities and deeper ones.

Darwin's thinking about analogy encourages Shelley to consider the limitations of the analogy between birth and imagination, and to see the limits of forming another in one's own image, as so many theorists of generation assumed. Must the generation of children and ideas be doomed to reprint clichés? If thoughts and art are the progeny of the imagination, does that mean an economy of replication and mimesis necessarily follows? Midwives often credited the imagination for the likeness between children and their parents (Sharp 77), and Darwin importantly viewed the embryon as a branch of the male parent, which meant that it could never be entirely its own cause and that female creativity could not even aspire beyond male mimesis. Victor buys into this kind of thinking when he imagines that all his progeny will do is worship him. So does the monster, who proclaims, "My vices are the children of a forced solitude that I abhor" (121). To what extent does "children" absolve him of responsibility, since they function as a screen with which he can distance himself from his own actions? My point here is that if Darwin teaches Shelley that analogy should neither be mistaken for identity nor stand in for absolute difference, then the generation of children and ideas should not be limited to replication. Simply put, children should not be forms of autobiography. She thus proffers three stories instead of one—Walton's, the monster's, and Victor's—to encourage the play of similarity and difference.

The novel thus operationalizes science with a standard of reproducible results, even as it worries about how the imagination's creativity will be overshadowed by verification. Moreover, insofar as men-midwives had very carefully to separate women's difficult labors from masculine intervention so as not to have to take the blame if something went wrong, the metaphor of imagination as birth runs the danger of making the parturition the culminating event. Indeed, once Victor has "given birth" he thinks he is done with his creature, even going so far as to clap his hands once the monster has disappeared.

Victor eventually comes to espouse what will become scientific objectivity, but Shelley warns that objectivity comes at too high a price because it denies that feelings have epistemological value. In a rare moment, when he concedes some blame for what has happened, Victor comments that "a human being in perfection ought always to preserve a calm and peaceful mind, and never to allow passion or a transitory desire to disturb his tranquility. I do not think that the pursuit of knowledge is an exception to this rule. If the study to which you apply yourself has a tendency to weaken your affections, and to destroy your taste for those simple pleasures in which no alloy can possibly mix, then that study is certainly unlawful, that is to say, not befitting the human mind" (37). There are several problems with this claim. First, Victor has never been able to obey it. Second, Victor blames the specific area of study for the weakening of the affections, but why should a particular area of study cause such a weakening? Once again Victor has no judgment from which to evaluate his thoughts. Third, to make any study "unlawful" because it disturbs the passions would divest human beings of their best accomplishments and would certainly remove anything of interest from the novel. One thing novels cannot sustain is homeostasis. If Victor makes a plea for objectivity, he simultaneously denies the emotional motivations that make the pursuit of knowledge feel worthwhile. Thus, Victor Frankenstein helps Shelley work out the ways in which the fruits of imagination can be evaluated so that the development of the imagination is possible.

THE TEMPLE OF NATURE AND *FRANKENSTEIN*

We have only scratched the surface of the connections between obstetrics and embryology and the novel, and Erasmus Darwin helps us deepen those connections.[48] Darwin's *Temple of Nature*, the source of Shelley's musings on the piece of vermicelli that miraculously began to move, had a much more powerful influence on *Frankenstein* than has been acknowledged. Darwin's larger project in the *Temple of Nature* is to illustrate analogies among reproduction, the progress of mind, and the progress of society.[49] As Darwin tries to show, development in the

womb recapitulates the history of the development of the earth: the origin of life in the sea is repeated in the womb and the fetus's surroundings by amniotic fluid. In his preface, Darwin claims to eschew "deep researches of reasoning; its aim is simply to amuse by bringing distinctly to imagination the beautiful and sublime images of the operations of nature" (preface). As Noel Jackson has perceptively remarked, for Darwin the imagination provides the catalyst for the researches of science, "pointing out the truths that science only later confirms" ("Rhyme and Reason" 183). I would add that in the same way that the generation and conception of ideas cannot be reduced to a method or formula, any confirmation is only temporary, and we should not forget that science is in the business of confirmation and refutation. The sublime wonders of the natural world and amusement are what attracts the human mind to the study of science in the first place. Darwin's underlying premise is that all these processes share a common organic development, and the uses of that assumption need testing. These sublime analogies, in turn, help Shelley connect microcosm to macrocosm and thereby relate the development of the individual, through perspectives of both body and mind, to societal development writ large. The comparisons between these forms of development suggest a common causality that demands further investigation.

Darwin relies on deism to offer a rational basis for faith that eschews the miracles of revelation, and thus he highlights the rational workings of the operations of nature from the embryo to the imagination through to the universe. While his version of God does not intervene in earthly affairs, his God works through rational, scientific processes, which Darwin documents. Shelley, by contrast, not only substitutes an electrical scientist in the place of God—Kant had called Benjamin Franklin the modern Prometheus—but also empties out Darwin's readings of natural cycles in terms of necessary progress and worries whether the emotions can be mastered by rationalism and whether they should be so mastered.[50] Where Darwin considers pleasure to be "the ground of knowledge and the end of human action" (Jackson, "Rhyme and Reason" 176), Shelley highlights how vengeance corrupts pleasure by transforming social interaction into sadism and pleasure's vulnerability to narcissism.[51] Shelley not only does not assume that imagination is a form of reasoning—it can be so only under certain conditions—but she also warns that Victor's arrested imagination will cut itself off from the world and thereby prompt only death and devolution. The abortion that is Victor's arrested imagination is also the monster of an arrested science that threatens the very extinction of society. What hope the novel offers is based on having learned from Victor's errors. Both authors combine mythology with science, with Darwin fo-

cusing on the Eleusinian mysteries and Shelley highlighting Prometheus, and they do so to bring empirical particulars together with universal narratives that help make sense of them.[52] If both mythology and science are ways of making mysteries intelligible, science might benefit from mythology's ability to frame intelligibility in terms of patterns, and the presence of the divine might encourage human beings to aspire to better themselves.

Darwin analogizes generation, imagination, and society, and he hopes that his sublime images will prompt further scientific study to add to any intelligibility mythology proffered. The implication here is enormous: if the development of the imagination parallels the development of the embryo, nature would unfold in a way that mirrors our rational conceptions, and if this were true, there would be no necessary gap between nature and our understanding of it. He argues that imagination functions in both generation and intelligence. In a note to *The Botanic Garden*, Darwin commented that "philosophers of all ages seem to have imagined that the great world itself likewise had its infancy and its gradual progress to maturity" (1: 1 notes to lines 101–06), and in this view the world is a kind of embryo. Darwin solidifies the gist of these connections at the very outset of *Temple of Nature*:

> God the First Cause—in his terrene abode
> Young nature lisps, she is the child of God.
> From embryon births her changeful forms improve,
> Grow, as they live, and strengthen as they move.
> Ere time began, from flaming Chaos hurl'd,
> Rose the bright spheres, which form the circling world
>
> (67 canto 1: 223–28)

Note Darwin's framing of chaos's presence at the beginning of time, which informs Shelley's turn to chaos at the moment of invention.

Darwin also helps license Shelley's myth of a man giving birth without women. Yet, if his theory of generation continually downplays women's contributions, it defines creation recursively so that the act of creation cannot be wholly new. This is perhaps because he wants human creation to work with God's and not supplant it. Canto 2 concerns the reproduction of life, and crucially reproduction is framed as a form of mimesis. Darwin writes, "But, reproduction, when the perfect Elf/Forms from fine glands another like itself" (*TN* 57 canto 2: 27–28). Here, the male seminal worm becomes spontaneously vital and unwittingly becomes a false figure for autonomy because the semen alone can't create all by itself. The process

by which it is produced, moreover, is a form of copying, which further undermines any potential autonomy. Darwin then gives imagination center stage:

> The potent wish in the productive hour,
> Calls to its aid Imagination's power,
> O'er embryon throngs with mystic charm presides,
> And sex from sex the nascent world divides (67 canto 2: 117–20)

The embryon here is shaped by the imagination's power. Darwin goes on to explain how the similarity of progeny to the parent is limited to the power of the male imagination, adding in a footnote, "It is not to be understood, that the first living fibres, which are to form an animal, are produced by imagination, with any similarity of form to the future animal; but with appetencies or propensities, which shall produce by accretion of parts, the similarity of form and feature, or of sex, corresponding with the imagination of the father" (ibid.). Darwin's language here anticipates Shelley's insistence that invention cannot produce substance. Imagination does not produce the similarity of form; rather, through "accretion of the parts" the embryon acquires appetencies of its own. But how exactly does it do that? Once again, at the very instance when autonomy or the creation of something new becomes possible, Darwin limits it. He argues, "There hence appears to be an analogy between generation and nutrition, as one is the production of new organization, and the other is the restoration of that which previously existed; and which may therefore be supposed to require materials somewhat similar" (additional notes 9). Underwriting the analogy is the supposition that both nutrition and generation work with similar materials. The net effect of this theory, however, was that women again would be blamed for monsters, since women were thought to be responsible for the nutrition of the fetus. Because "appentencies" are somewhere between a mechanical drive and a form of desire, recalling Buffon's interior molds, the issue of autonomy once again rears its head, and Darwin tries to finesse the problem by making generation like a form of restoration. Analogy then confirms the rationality of the universe, even as it papers over the moment of creation. Because of Darwin's deism, he cannot offer a version of creation that makes God dispensable.

Darwin is also helpful for understanding why the imagination has such prominence in *Frankenstein*. He makes the imagination responsible for assembling trains of thought, but this is once again to make new thoughts into combinations of old ones. Not only does Darwin make pleasure a central engine of brain development—he writes that

First the new actions of the excited sense,
Urged by appulses from without, commence;
With these exertions pain or pleasure springs,
And forms perceptions of external things.
Thus, when illumined by the solar beams,
Yon waving woods, green lawns, and sparkling streams,
In one bright point by rays converging, lie
Plann'd on the moving tablet of the eye;
The mind obeys the silver goads of light,
And irritation moves the nerves of sight.

These acts repeated, rise from joys or pains,
And swell Imagination's flowing trains;
So in dread dreams, amid the silent night,
Grim spectre-forms the shuddering sense affright (105–06 canto 3: 55–68)

As Darwin recounts it, the brain is stimulated by external stimuli. It associates those stimuli with pleasure or pain, and thus begins to create ideas and sensations out of what were mere irritations. Darwin explains in a footnote: "Sensation is an exertion or change of the central parts of the sensorium, or of the whole of it, beginning at some of those extreme parts of it, which reside in the muscles or the organs of sense. Sensitive ideas are those which are preceded by the sensation of pleasure or pain, [and] are termed Imagination, and constitute our dreams and reveries" (*TN* 107n). Once again, the question is, how does the imagination create something new if it takes its cues from the following of our pleasures?

Darwin again insists upon the formative role of the imagination in the development of the mind:

Call'd by thy voice, Resemblance next describes,
Her sister-thoughts, in lucid trains or tribes;
Whence pleas'd Imagination, oft combines,
By loose analogies, her fair designs (181 canto 4: 305–08)

Yet, in another footnote, Darwin cites Hume's distinctions between associations of contiguity, causation, and resemblance. What begins then as loose analogy should ideally through ratiocination be defined into either a mere temporal overlap, or a relationship of causality, or one of mere similarity. Darwin thus helps Shelley to see the stakes of making meaning out of resemblances.

Darwin's descriptions of the evolution of the mind from irritation to sensation

parallel Shelley's description of the monster's birth into consciousness. That she underscores this parallel makes the monster one of us, and not its own species:

> Several changes of day and night passed, and the orb of night had greatly lessened when I began to distinguish my sensations from each other. I gradually saw plainly the clear stream that supplied me with drink, and the trees that shaded me with their foliage. I was delighted when I first discovered that a pleasant sound, which often saluted my ears, proceeded from the throats of the little winged animals who had often intercepted the light from my eyes. I began also to observe, with greater accuracy, the forms that surrounded me, and to perceive the boundaries of the radiant roof of light which canopied me.
>
> (*Frankenstein* 81)

Not only do pleasure and pain have formative force, but also the monster moves from indistinct sensations to distinct sensations and then to ideas. He claims, "My sensations had, by this time, become distinct, and my mind received every day additional ideas" (81). As the mind develops, it shifts from irritation to sensation, and the door opens to the voluntary when the mind is no longer just passively taking things in.[53] Delight has formative force, but crucially from Shelley's perspective it is not enough to sustain either virtue or progress. Where Darwin underscores the imagination's role in dreams, Shelley worries about its connections to the will. Though the monster claims that if he is made happy again, he will return to virtue, the problem is that in this view virtue becomes a product of external circumstance, with nothing to do with the will. "O my creator," he implores, "make me happy, let me feel gratitude towards you for one benefit!" (120). When virtue becomes contingent upon happiness, it is no longer self-generated but rather relies upon contingency.

But Darwin is left with an even larger problem. Although he recognizes that sexual reproduction allows the embryo to benefit from both parents, his framing of sexual reproduction still elevates the male over the female even as it limits the male imagination to mimesis. Only the male imagination has the power to stamp sex onto the child. How then does anything like sympathy arise, which requires identification with another across the chasm of difference?[54] Darwin offers no explanation and has sympathy descend from the heavens in canto 3:

> The Seraph, Sympathy, from Heaven descends,
> And bright o'er the earth his beaming forehead bends;
> On man's cold heart celestial ardour flings,
> And showers affection from his sparkling wings (147 canto 3: 467–70)

Against Darwin's overflowing optimism about the progress of mankind and his "pleas'd imagination," Shelley offers a much starker vision. For Darwin, progress necessarily happens at three levels: the act of generation, the development of mind, and the progress of society. Shelley takes each level and evacuates it of progress, explaining the lack of progress by the recursive nature of creation. In the novel's nested narratives, these levels arise formally in the creation of the body by analogy in Victor's arrested science; the monster as abortion; and Walter's exploration, which is literally arrested in the polar ice. Against an inevitable teleology of progress, Shelley warns that there is hard work to be done if change is to be had. Moreover, it is precisely when the imagination is pleased that danger is afoot.

The male embryon, the monster, represents disaster. The fact that his reproduction is asexual prevents the monster from being able to take advantage of the contributions from both parents. In describing the evolution of life forms, for instance, Darwin made it clear that sexual reproduction trumps asexual reproduction. Of the former, he comments, "The Reproduction of the living Ens / From sires to sons, unknown to sex, commence" (61 canto 2: 63–64). He adds, "no seed-born offspring lives by female love" (62 canto 2: 74). As if that were not enough: "In these lone births no tender mothers blend / Their genial powers to nourish or defend; no nutrient streams from Beauty's orbs improve / These orphan babes of solitary love" (65 canto 2: 104–06). In this view, the reproduction of the monster is a solitary love that, because it cannot be nourished by both parents, is inherently more primitive. Even worse, "birth after birth the line unchanging runs, / And fathers live transmitted in their sons" (65 canto 2: 107–08). If, on the one hand, Darwin insists upon the superiority of sexual reproduction to asexual reproduction on the grounds that sexual reproduction allows for the blending of characteristics from both parents while asexual reproduction offers no possibility of change, he nonetheless models even sexual reproduction on asexual reproduction insofar as the male embryon is a "branch" of the male parent. For Shelley, this raises the issue of why theories of generation regress into reproductions of versions of the self, and why those theories, with the partial exception of Darwin, did not account for the value of the different materials that each sex brought to generation. Why, in other words, did sexual difference not make a difference? Shelley underscores this failure with the untimely demise of her main female characters, and she couples their deaths with the fact that their femininity does little more than perpetuate patriarchy.

The monster refers to himself as "an abortion, to be spurned at, and kicked, and trampled on" (189).[55] As a monster, he is an abortion in the sense that his development has gone awry, but the term literally refers to an embryo that cannot

sustain itself outside the womb. Though the monster can physically sustain himself, he cannot do so emotionally, and promises to end himself.[56] The logic connecting these ideas starts with the premise that nature will not permit monstrous deviations and thus spontaneously aborts them. For Shelley, "abortion" suggests her awareness of the gaps between the embryo and personhood. The monster's self-identification in terms of an abortion then is ironic in ways we have yet to grapple with. At a simple level, the monster seems blithely unaware that his status as an abortion logically cancels out whatever sympathy one might have for him. Because embryologists, especially after epigenesis, considered personhood not to be innate but to be a product of both biological and cultural development, the monster as abortion has no standing from which to ask for sympathy. The fact that the monster decides for himself to abort himself points to a world where free will exists but providence does not. Yet free will or autonomy is limited to self-cancellation. Walton looks upon Victor as an abortion: he refers to his death as an "untimely extinction of [his] glorious spirit" (187), but this is to ignore Victor's own responsibility for his failures, thereby recalling how the maternal imagination papered over the failures of male midwives.

The monster is also an abortion in the sense that his imagination and his emotions have yet to be properly developed.[57] Percy Shelley thought the imagination was crucial to sympathy, but what was the origin of sympathy? Darwin has no other explanation than to have sympathy descend from the heavens. Although Victor has been raised in a loving family, that history does not inoculate Victor's sensibility from damage. Victor, we recall, deliberately hardens himself so he can study death. "My attention," he reports, "was fixed on every object the most insupportable to the delicacy of the human feelings" (34). Shelley's placement of the indefinite article "the" in front of feelings dramatizes Victor's talent for distancing himself from feeling. She underscores his perversity when he admits that he had "tortured the living animal to animate the lifeless clay" (36). Thus, although pleasure and pain shape the meaning of our experiences, they do not necessarily do so for good. When we bear in mind Jessica Riskin's study of how important sensibility was to Enlightenment science because it encouraged a blending of emotion and experience, Victor once again comes up short as a scientist.

Insofar as emotional education is presented as a form of mimesis, Shelley's point is that merely imaginatively copying the emotions of others is insufficient. The monster is yet to be developed because he holds onto theories like the mimesis of emotions, which prevent the possibility of his own development. Like Victor, the monster substitutes imagination for personhood, and thus essentializes his identity, which prevents him from wanting to develop either his imagination or

his self. In this view, the imagination can only reproduce what it is given, and it is thus limited to asexual reproduction. After he finds the cottagers, he "dared to fancy amiable and lovely creatures sympathizing with [his] feelings" (106). After reading about patriarchy, the monster submits, "The patriarchal lives of my protectors caused these impressions to take a firm hold on my mind; perhaps, if my first introduction to humanity had been made by a young soldier, burning for glory and slaughter, I should have been imbued with different sensations" (104). Here, the monster understands his own mind and imagination as a block of Lockean wax, to be inscribed upon. And, not surprisingly, after he reads Werther, he identifies with his diseased imagination. If all one can do as a human being is to replicate the emotions of others, how does autonomy happen? And, given that sensibility leads to both personhood and monstrosity, how does one develop feelings in such a way so as to prevent monstrosity?

If we press the metaphor of abortion further, we must ask why Shelley has the monster come to life in the form of an adult and completely sidestep embryonic development while at the same time making Victor's gestation of the monster last nine months. Nancy Yousef has traced the discourse of autonomy in the eighteenth century and asks why this discourse ignores the fact that human beings come into the world completely dependent upon others, and largely dependent upon maternal care. Where she argues that Shelley finds autonomy an unnatural place to begin development, I show how the problem begins even earlier in the discourse of generation. Victor at times denies his creature autonomy. At other times, he labels the monster a separate species, granting him an independence but also complete isolation. And yet, by doing so, does his development have anything to say about human development? Blumenbach, we recall, had insisted that the astonishing uniformity among the different kinds of monsters meant that the causes of their deviations were regulated by the same fixed laws that pertained over normal births (*Essay* 82), and thus he insisted that monsters exemplified natural laws and were not exceptions to them. In the same way that her mother had argued that women were really children because their intellects had been neglected, the tension between the adult form of the monster and its emotional adolescence comments on how autonomy is at present culturally unworkable because it will not deal with the realities of human dependence, because it foists the development and maintenance of social bonds solely onto women, and because it insists on generation as a reproduction of the self. In an important way, then, women were also abortions, though not of nature but by culture.

The development of the mind does not take place when the imagination is arrested. In this view, Darwin's continuum of the imagination from looser to

stricter analogies at least imposes the possibility of improvement. As the bodies pile up in *Frankenstein*, society has not progressed but rather is in peril. Thus, for Shelley, the progress of human society could not be the barometer against which nature's progress could be understood. As a corollary: science is no necessary march of progress and no necessary form of mastery. As with the macrocosm, so to with the microcosm. To make this clear, Shelley has the monster refer to himself as an abortion and acknowledge the future extinction of his spark, and this in turn casts dark shadows on the progress of society and science. So much for the lasting legacy of the modern electrical Prometheus. At a local level, then, how fitting that *Einbildungskraft* does not lead to much education even as Victor's science, for all its proclaimed modernity, keeps circling back to alchemy and the idea that women's imaginations are responsible for monsters. Victor grants his imagination too much autonomy. As men-midwives admit, although the idea that the female imagination could produce monsters had no scientific standing, that did not put an end to the damaging consequences of the maternal belief that it could do so. And yet the novel is not a condemnation of science but rather a condemnation of a version of science as mastery because mastery does not allow for development. Although conception may be an organic process, it needed ways beyond happenstance for improvements to occur and had to get rid of theories like genius that would prevent the very possibility of improvements.

Finally, society in *Frankenstein* is brought to the brink of collapse. Mothers and wives are killed, and, since they maintain the social bonds, their absence does not bode well for society. One way Darwin finesses his teleology of progress is by insisting that death leads to reanimation. "Hence, when a Monarch or a mushroom dies,/Awhile extinct the organic matter lies;/But, as a few short hours or years revolve,/Alchemic powers the changing mass dissolve" (188 canto 4: 383–86). He thus views "the wrecks of death are but a change of forms" (189 canto 4: 398). When Shelley compares the monster to a phoenix rising from the ashes, she once again revises Darwin. Darwin wrote, "A filial phoenix from his ashes springs,/Crown'd with a star, on renovated wings" (191 canto 4: 413–14). It "Ascends exulting from his funeral flame,/And soars and shines, another and the same" (415–16). The monster by comparison "ascends [his] funeral pile triumphantly, exult[ing] in the agony of the torturing flames" (191), except that he is an aborted phoenix and his triumph is in torture. With this revision, Shelley accomplishes two things: she questions whether pleasure can be a necessary instrument of progress, and she moves our attention to Walton and his crew who survives. If there is to be progress, it must come from readers who have been impacted by the horrific vision she presents. In a further irony, the monster renounces Darwin's theory of necessary progress:

"When I call over the frightful catalogue of my deeds, I cannot believe I am he whose thoughts were once filled with sublime and transcendent visions of the beauty of the world. But it is even so. The fallen angel becomes a malignant devil" (189).

I have shown how both obstetrics and embryology absolutely relied upon comparative analysis of development across species and across the mind and body divide. Crucially, the uses of those comparisons and their extent cannot be known in advance, making the science not about mastery.[58] If science eludes mastery, so does human development. The midwife Jane Sharp stipulates that the child does not "live" until around forty-five days (90). Because Victor does not see a gap between the "birth" of the monster and his personhood, he thinks that the giving of life is the compass of his responsibility and that monstrosity is only a morphology. Tellingly, both the monster and Victor refuse to think beyond their own individual development, each preferring instead to see himself as the most deserving of a pity party. Even worse, after having heard the monster's story of his abandonment, Victor insists, "No creature had ever been so miserable as I was; so frightful an event is single in the history of man" (167). His inability to draw comparisons between the two of them is what blinds him to the meaning of the monster's promise that "I will be with you on your wedding night." In the same way that the monster has been deprived of all friends and companions, he seeks to make Victor truly alone. By encouraging some sympathy for the monster, Shelley argues that he should not be othered, and she reinforces relationality by making Victor the monster's doppelgänger and by narrativizing parallel courses of development.

Shelley, of course, frames her novel so that readers have no choice but to compare the development of the characters. Hence, the monster and Victor are locked into a mutual competition, one whereby they each claim autonomy but cannot see their interdependence. Walton thus provides a hint of hope when he allows the crew to convince him to turn back and thereby to think of the needs of community over individual ambition. While Darwin had argued that pleasure was an engine of improvement, Shelley shows how vengeance can become a kind of perverse pleasure that can only imagine mutual destruction as its object. As the monster recounts, "A frightful selfishness hurried me on, while my heart was poisoned with remorse" (188). Even at the end, he is unable to claim responsibility for his own feelings.

To the extent that personhood is a product of development, so too must monsters be made and not born. Shelley describes the monster's early days, but, instead of the development of physical features, she describes the growing distinctiveness of his five senses in a way that recapitulates the development of his features becoming distinct. The monster is at this time an emotional embryo becoming a

fetus, even if he is eight feet tall. Because generation is limited to the contributions of a single parent and because emotions are learned by replication, there is no outcome where autonomy is realistic and healthy. Hence, Mary Shelley does not share Erasmus Darwin's optimism.

What then does all this mean for both the Romantic imagination and science? For Mary Shelley, the imagination generates ideas and analogies, but that does not mean its fruits are necessarily valuable. In thinking about imagination as an engine of creativity, she recognizes the degree to which its very strengths—its ability to think outside the box—comes only from its weaknesses—the connections it suggests are intuitive, dreamlike, and unconscious and therefore outside the box but not necessarily helpful.[59] Likewise, in his specification that the imagination pursue "stricter analogies," Erasmus Darwin helped to realize the value of thinking about science as an organic process that enabled the spontaneous encounter with objects of study. Because it produced work that could be evaluated, the operationalization of the goal of stricter analogies, not the goal itself, made the goal useful. When evaluated against other scientists, Victor Frankenstein comes up very short, but that does not mean that Shelley gives up on either science or the imagination. Instead, she focuses on what might encourage their development, and, since what that development was could not be defined in advance, she considers how theories of genius, a lack of discipline, and dogmatism likely foster abortions since they encourage the status quo. Setting criteria against which to evaluate the imagination's contributions becomes the requisite for the possibility of its development and, through it, the development of science.

Notes

INTRODUCTION

1. See Porter, who argues that the inductive method of seventeenth-century experimental philosophy serves as a Romantic strategy for dealing with information saturation across fields (introduction).

2. Richard Kearney links the demise of the imagination with the decline of humanism's fortunes. He argues for a postmodern imagination that will preserve narrative identity and creativity (32–33). William St. Clair labels the imagination "a key concept of later constructions of Romanticism . . . [because] it was seldom approved of by those who believed reading had lasting effects" (283), but this is to ignore its contemporaneous scientific and cultural importance. It is especially telling that, in a recent book on virtual reality, Peter Otto dispenses with the imagination almost entirely (*Multiplying Worlds*). By contrast, when Kant argues that "a pure transcendental synthesis of imagination . . . underlies the possibility of all experience" (*CPR* A102), he made it impossible to do away with the imagination.

3. Damrosch notes that Blake, like Boehme, "sought a richer apprehension of this world, not an escape to a higher realm" (124). In *The Politics of Imagination in Coleridge's Critical Thought*, Leask connects Coleridge's theory of imagination and his interest in *Naturphilosophie* to his desire to replace the aristocracy with the professional middle class.

4. Beiser would suggest "formal requirements" instead of "conditions" because human cognition requires forms it can recognize, and "formal requirements" are more modest than "conditions," which might promise too much. I use "conditions" to avoid splitting hairs this early in the book, but I think Beiser is right. Beiser describes the paradox of Kant's transcendental subject thusly: the transcendental subject cannot know itself because self-knowledge "requires the application of the categories; but to apply the categories to myself is to make myself passive and determined" (*German Idealism* 156). Thus, principles like the unity of apperception are a formal requirement that tells us that all representations have a subject, but it tells us precious little about the nature of the individual subject.

5. The Eighteenth-Century Collections Online database of Science, Medicine and Technology lists 2,962 items that contain the word "imagination." See http://find.gale group.com.proxyau.wrlc.org/ecco/subjectAreaLimiter.do?qrySerId=Locale%28en%2C%2C%29%3AFQE%3D%280X%2CNone%2C11%29imagination%3AAnd%3ALQE%3D%28BA%2CNone%2C4%290LRM%24&searchResultsPerPage=10&inPS=true&prodId

=ECCO&userGroupName=wash11212&tabID=T001&searchId=R1. Some quite select examples documenting the centrality of imagination to Romantic science follow. In his unpublished 1784 paper, "Meteorological Imaginations and Conjectures," Ben Franklin speculates on how hail can fall during the summer and imagines parts of the atmosphere where it is always winter. He distinguishes between inquiries that are worth it and not. Davy credited his love of "invent[ing] and form[ing] stories of my own perhaps this passion has produced all my originality . . . I never loved to imitate but always to invent. This has been the case in all the sciences that I have studied—hence [inviting?] of my errors" ("Personal Notebooks" HD/13/D, page 23). Astronomer Jean Sylvain Bailly credited the imagination with the ability to "rappeller les sensations en nombre, d'enchainer les idées de leur rapport, et d'en former des composes suivant un plan et relativement à certaines vues. C'est cette imagination qui fait invention" (1: 116). Geoffroy St. Hilaire wrote, "Je venais d'imaginer une nouvelle methode de determination tant des organs que de leurs materiaux constitutifs" when coming up with his theory of amniotic adhesions to explain monstrosity (2: 540). He had initially warned against the popular imagination's tendency to excitation, especially over monsters (2: 500). Yeo notes that Whewell recognized that "great discoverers were imaginative and speculative in their quest for knowledge of nature" (13).

Though he valued the imagination, Einstein lamented that "humans have a poor faculty for independent thought and creative imagination. Even when the external and scientific preconditions for the formulation of an idea have long been present, an external incentive is mostly needed for its emergence; the subject must be right in front of a person's nose, so to speak, for the thought to arrive" (14:466).

6. In *Life*, Denise Gigante argues that, when Life becomes a "power," it threatens to leave the orbit of representation and thus slip out of imaginative control (2–3). Yet I think this is to overestimate imaginative control and underestimate the protocols they put in place to operationalize such control. Gigante captures how the biological and aesthetic come together in the period. She submits that cell theory in the 1830s killed off Romanticism's sense of unity between beauty and life (36). Amanda Goldstein takes an opposite tack in *Sweet Science*, about which I will have much more to say below. While her materialist approach astutely captures the negative surrounding life, it comes at the cost of separating science from aesthetics and of not taking seriously enough scientific interest in phenomenology.

7. The ECCO Science, Medicine, and Technology database lists 2,512 instances of "phenomena," suggesting that this kind of bracketing was common within science, and that perhaps Kant's concept of the thing in and of itself may have owed something to the science of the times.

A disciplined imagination that could offer useful hypotheses was considered crucial for scientific advancement. Yet how could one possibly know what was useful in advance of its application? In *Anatomical and Physiological Lectures*, for instance, John Abernethy insisted that "we know nothing of the properties of bodies, nothing of electricity or magnetism; nothing of the properties of the percipient; we know that from these motions of matter it forms certain notions of external objects" (333). Methodologically, this could lead to seeing the value of a thesis and an antithesis, and then working through to some kind of synthesis or dialectic. William Whewell may have advanced scientific induction, but we should not forget he was a Kantian.

On the pervasive influence of Kantianism on nineteenth-century science, see Friedman and Nordmann, Robert J. Richards (*Conception*), and the August 2016 special issue of *Studies in History and Philosophy of Science*, with its cluster of essays on "Kant and the Empirical Sciences." Nassar shows how analogy in Kant works to allow him to extrapolate rules from one domain to another (62–65). Malcolm Nicolson shows Kant's extensive influence on geography. Class argues that F. A. Nitsch extended Kant's influence in 1790s Britain significantly (chapter 1).

On phenomenology and science, see Seamon and Zajonc; and Hankins. Though Seamon argues that phenomenology was how Goethe sought to know the "thing in itself," the examples he cites from Goethe all rest in experience (2–3). "Phenomenology" was coined by the Swiss mathematician Johann Lambert in 1764, and Kant considered its goal to be the evaluation of what sensibility could in fact know. Although Seamon and Zajonc understand phenomenology to be about experience without concepts, as it would later become, for Kant this is not possible. Steinle highlights the importance of "systematic phenomenology" in which "multiple regularities are knit together" for the period's experiments (*Exploratory Experiments* 322–26). For an innovative and outstanding study of form as rhythm, see Janina Wellmann, *The Form of Becoming*, especially the chapters on physiology and embryology, which think about how rhythm provides a structure for becoming.

8. Priestley uses "imagination" to refer to theories or hypotheses needing confirmation. For instance, in "Priestley's Phlogiston and the Conversion of Water into Air, 1783," he "imagined [phlogiston] consisted of it, and something else. However, I was then satisfied that it would be in my power to determine in a very satisfactory manner whether the phlogiston in inflammable air had any base or not" (3). Of course, phlogiston, believed to be the fatty earth that burned away during combustion, is really oxygen. He also uses imagination when applying a new process to other substances: "Being now master of a new and easy process, I was willing to extend it to other liquid substances, and I presently found, as I then imagined, that, by this other means, I could give permanent aerial form to any liquid substance that had been previously thrown into the form of vapour" (21). He also uses "imagined" to come up with reasons why his results were not as expected (8). Contrast these to how Priestley tars Burke with a "heated imagination." See Barrell 12–20.

9. In his *Essais sur L'Ame*, Bonnet wrote, "N'oubliez point que ce que nous appellons essence des choses, n'est que leur essence nominale" (14).

10. Schwartz uses "diplopia" to name a Romantic "cognitive inconsistency between what is perceived and what is actually present" (29).

11. Kant, *PNM* 313. Ian Hacking and Bruno Latour argue that facts, interpretations, procedures, theories, and social relations are coproducing, thereby enabling a fit between the theories that last and the world (Hacking 31). Coleridge got there first and pursues the subjective and objective lines of argument in his *Biographia* simultaneously.

12. On this problem, see Beiser's *German Idealism: The Struggle against Subjectivism, 1781–1801*. In his March 15, 1819, philosophy lecture, Coleridge insists that scientific researchers are not immune from "gratifications which its novelty affords to our curiosity . . . and by the keener excitement which an unsettled mind is bound to inspire" (*PL*, 343; all citations to Coleridge's *Philosophical Lectures* will be from the

Coburn edition, unless otherwise stipulated). He continues, "He who supposes science possesses an immunity [from influences] like this, knows little of human nature, and how impossible it is for man to separate part of his nature wholly and entirely from the remaining parts" (ibid.). Science involves emotion and needs to deal with it.

13. Matter has been subsumed by physicalism, the doctrine that all things which exist are entities recognized by physics (J. Kim 11–14). Unlike materialism, physicalism accounts for entities like energy and fields. Edwards in *Artscience* assumes that the line between the arts and sciences can be a generative source of creativity because it demands negotiating difference. Of course, that line was never a natural feature, especially since "art" could mean skill resulting from practice.

14. Engell shows that Alexander Gerard, Mark Akenside, Johann Fichte, and Percy Shelley all used the magnet to explain the power of individual imagination (260).

15. Coleridge insists, "It is clear that abstraction is an imaginary process" (*Logic* 14).

16. Daston associates Romantic science with the second modernity within the history of science ("When Science"). She argues science then became a salaried profession and allied itself with state interests.

17. Richard Saumarez defined the principle of life "by the energy of which various species of matter are converted to one kind under one system" (*New System* 1: 18). Count Rumford credited accidents and "the playful excursions of the imagination" for his experiments surrounding the source of heat in friction. See his 1798 *Philosophical Transactions* paper.

18. Neuroscientist Nancy C. Andreasen studies highly creative people and focuses on the association cortices of the brain. See chapters 5 and 6 of *The Creative Brain*. By cultivating relationality, Romantic science primed the pump for the exploitation of various kinds of sensory information. Did this insistence upon relationality foster synesthesia?

19. In October 1829, Mary Shelley wrote, "The discoveries of science, engrossing as they are, and often delightful, are inefficient to take the sting from life, changing its burthen to gladness: this miracle is left for the affections." See Shelley's *Reader*, edited by Bennett and Robinson, page 365.

20. Gregory warned that "a student of genius . . . gives so much room for imagination, and so little for experiment, apparently ingenious, but really trifling and useless" (*Lectures on the Duties* 190). The imagination of a genius was too preoccupied with "subtleties of its own creation," so much so that it becomes "incapable of a patient . . . examination of nature" (ibid.).

21. In his published papers, Faraday regularly uses the phrase "forms of experiments," and "form" here facilitates continued improvisation, as it implies a kind of looseness. Romantic form is not mere abstraction, because it has a sensuous presence that must be felt. Yet that sensuous presence is not identical to ontology, and thus feelings can prompt better articulations of form. Thus, when J. Robert Barth insists that Coleridge would never "accept a merely formal correspondence between 'idea' and 'things'" (131), he neither grants form nor correspondence sufficient complexity. Recall Kant recognizes that things exist but that form is merely what we can claim to know about them. For Kant, the appearance of the thing is "always to be regarded as something actually given—except insofar as the object's character depends on the

subject's way of intuiting this given object" (*CPR* B70). Crucially, appearance is of something, and this view, the object is not denied. We just can't know it.

22. In *Diotima's Children*, Beiser connects the aesthetics of Alexander Baumgarten back to rationality and rules: it was a "science of beauty" (3).

23. Morphology gave similarity and difference a dialectical kick. Von Baer writes in "On the Genesis of the Ovum," "The study of morphology has long taught that all the differences of any organ whatsoever—not to speak of all the organs—exist within the limits of strong similarity" (142). Goldstein argues that "morphology manages to represent life as a condition rather than a power, to turn from self-sufficient integrity toward a proto-ecological notion of contingency and interrelation" (*Sweet Science* 74). Her account of Goethe highlights his gentle mocking of Kant's epistemological modesty (126–29). Wellmann suggests that Goethe's insistence upon seeing metamorphosis in terms of alternating patterns of contraction and expansion "prevents the particulars from prevailing" (121). Yet, as Nassar points out, Kant warned that the analogy of form should not be used to make explanatory claims, especially about the origin of species (65). For an overview of transcendental anatomy in Romanticism, see Rehbock.

24. Tresch suggests that for Comte, relationality did not entail ontological claims (186). In *Émile*, Jean-Jacques Rousseau insists that relationality at least initially cannot be perceived but must be felt: "The child perceives the objects, but cannot perceive the relations linking them" (169). Kauffman shows how materialism works through aesthetic strategies and makes the important corrective to the New Historicism that Romantic art is not about aesthetic delusion or ideology but rather offers art as a formal illusion and thus resists aestheticization (698–702). Haekel submits that literary critics are still within the Romantic episteme, insofar as the period's literature made literary theory part of its own definition (*Handbook* 9–10).

25. Janelle Schwartz suggests that because Blake manipulates the ground around the form in relief etching, his creations are a kind of "emboîtement for artistic creation" (125). While I appreciate this thoughtful extension of form, there are several problems. He writes on the plate with an acid resist, and that too is part of form. Preformation further grants God all the power, insisting on a binary between humanity and divinity.

26. To wit, Schwartz tracks how Erasmus Darwin uses "unchanging but in form" to talk about differentiation in generation and regeneration (chapter 2).

27. Helpful here is J. Robert Barth's definition of imagination as "the faculty by which the multiform reality of the world is seen in relationship" (30).

28. Given how much we are learning about our brain's creation of our perceptions of reality—that much of it is unconscious and affective—Kantian epistemology and its insistence upon thinking about things in terms of appearances acquire even greater power. See, for example, Hoffman.

29. In a long footnote on Chimborazo, Humboldt does warn that although narratives of mountain expeditions have captured the public imagination, they are of "very little scientific value" (172).

30. To get around the imagination's status as black box, Asma names "evolution" as its author, and this, in turn, grounds a dominant primitive imagination that works through the limbic system (47). In addition to Nancy Andreasen's work, another major

neuroscientific approach to the imagination is to connect it to "mind wandering" and to the "default mode network," a term coined by Marcus Raichle in 2001. This network encompasses both the rich simulation of things not present and abstraction. Because the "system" connects kinds of activities that are so different, is it a useful heuristic? For more on this debate, see the Imagination Institute's "Neuroscience Retreat."

Faraday stipulates the following as good science: "those philosophers who pursue the inquiry zealously yet cautiously, combining experiment with analogy, suspicious of their preconceived notions, paying more respect to fact than a theory, not too hasty to generalize, and above all things, willing at every step to cross-examine their own opinions, both by reasoning and experiment" (*Experimental Researches*, Dec. 1837, page 1).

31. In *Memoirs of the Literary and Philosophical Society of Manchester*, Thomas Barnes argues that "the vigour of the imagination will give correspondent vigour to the judgment" (1: 375). Because the mind is unified by a common spirit, Barnes insists the "imagination giv[es] strength and clearness to the understanding" (1: 378). Honorary members of this society included John Birch, Erasmus Darwin, John Haygarth, Antoine Lavoisier, Joseph Priestley, Alessandro Volta, and Josiah Wedgwood. Dalton was a member and later became its president. Most of his laboratory work was undertaken in the society's house.

32. On reinterpretation: scientists are always revising previous observations and, in many cases, dramatically revising what is being seen. Huneman shows how Schelling and Hegel were influenced by Kant to think of nature in terms of hermeneutics, that is, to interpret it as being like an organism (72–74). Hanna underscores "Kant's fallibilistic thesis to the effect that rational insight yields at best only a subjective aspect of *a priori* knowledge, or conviction, but not, in and of itself, objective certainty" (22). In this view, blind imagination is not a threat, but only insofar as one factors in its blindness.

A word about binary thought is perhaps in order. To the extent that deconstruction names binary thought the enemy insofar as it leads to an ideological privileging of one side over another, it cannot grasp the power of it. Binary thought is so pervasive because it makes knowledge symmetrical and thus allows claims for one side to speak automatically (by negating) the other side. In this view, binary thought functions to make cognition efficient. I am indebted here to Nate Harshman and to his conversations with me about information and symmetry. Ideology may be an outcome, but we should not underestimate what the symmetry of the binary allows us to do. Romantic science is such a fruitful area of concern because of its power to reconfigure binaries. In that incessant work of reconfiguration, the polarities of thought literally energize the field. Of course, Blake ups the ante with his fourfold symmetry.

33. See Dear, *Intelligibility*; and Porter, who argues that Baconian induction was transformed into a "science of relations" (52). In the same way that current science allows for future verification, the Romantics see unity as something that will be more fully verified in the future. In Orsted's "Metaphysics of External Nature," he stipulates that "no experience can arise except through a necessary link between several observations" (*Selected Scientific Works* 81). He deduces from this, "Phenomena, insofar as they are simultaneously perceptible in space, are in interchange, i.e., one acts on the other" (82). Relationality becomes central to both experience and to the interaction

between objects. In 1905, Poincaré argued that "the aim of science is not things themselves, as the dogmatists in their simplicity imagine, but the relations between things" (xix). Devin Griffiths argues for analogy as a comparative method between literature and science during the time between the Darwins, Erasmus (Charles's grandfather) and Charles.

34. In *Meteorological Observations and Essays* (1834), Dalton uses "imagination" to mark a hunch, as in "it may be imagined that the relative velocity of the winds, should be continually on the increase" (90). In his "Twelfth Philosophical Lecture," Coleridge criticizes early philosophy for allowing the imagination to "transfer its own experiences to every object presented from without" (*PL* 340). As a consequence, "forms of thought proceeded to act in their own emptiness" (341). He encourages experiment as a counter to this specific error.

35. Geneticist François Jacob reminds us that Darwinian evolution "cannot be directly verified in any way" but has "scientific character because it opens itself up to experimental contradiction" (13). If verification fails, science turns to falsification.

36. The Romantic distaste for rules could be rhetorical. Beiser reminds us both that rules defy creativity predominantly in their misapplication and that, because pleasure was considered rational, rules were not taboo (*Diotima's Children* 15, 23). Engell quotes Goethe on the fact that although "the imagination appears to have no rules . . . [I]t becomes regulated . . . through feeling, through moral considerations, through the need of action, and most happily, . . . through taste" (280). Even as Hazlitt defines "expression" beyond rules in "Table Talk," he smuggles rules in through the back door when he compares the imagination to a lodestone working through elective affinities (6: 47). Elective affinities, of course, had been standardized into tables by eighteenth-century chemists, making them subject to rules. In his *Anthropology*, Kant initially argues that "the realm of imagination is the proper domain of genius because imagination is creative and, being less subject than other powers to the constraint of rules, more apt for originality." If originality initially requires the breaking of rules, Kant is quick to add that "every art needs certain mechanic basic rules—rules for making the work suit the Idea underlying it" (93). By making aesthetic taste an instance of the free lawfulness of imagination and not a counter to it, Kant allows creativity freedom in the pursuit of rules.

37. Redfield's immediate subject is "beauty," because it "names and conceals the problems of judging judgment" (7). He suggests that "aesthetic judgment is a free play that is harmonious with, or analogous to, mere rule" and is therefore analogous with the logical and the ethical" (31). This analogy allows the bildungsroman to be a metonym for literary theory. For Kant, synthetic principles attend to empirical facts by harmonizing them into rules.

38. Kant insists, "The principles of possible experience are then at the same time the universal laws of nature, which can be cognized a priori" (*PMN* 306).

39. John Barrell argues that, when the creativity of the imagination went beyond a limit, "aesthetics was anxious to pass the concept over to psychiatry" (6). *Imagining the King's Death* thus focuses on the imagination as it was used in political writing from 1793 to 1796.

Perhaps to limit the novel's appearance of raving, Percy Shelley argued at the outset of his preface to Mary's *Frankenstein* that "the event upon which this fiction is

founded, has been supposed by Dr. Darwin, and some of the physiological writers of Germany, as not of impossible occurrence" (5).

40. In *Historia*, Pomata and Siraisi show that history and natural history were conflated up until the Enlightenment, another reason why science and literature were not clearly distinct. Mary Wollstonecraft saw no split when she recommended that women employ their minds on "gardening, experimental philosophy, and literature" (80). Keats's chemistry teacher, William Babington, opened his "Lectures on Chemistry" by recounting that it had been considered both a science and an art. He later distinguished the two by labeling art "manual" and science "mental" (1–2). For a critique of the limits of Snow's "two cultures" arguments, see James ("Introduction").

If recent decades have replaced Snow's two cultures of arts and sciences with one culture, neither framework gets it right. I suggest, with Klancher's help, that the arts and sciences were force fields in the Romantic period, and at stake in the activation of differences was the claim of creativity. Of course, there could be so much interaction because the scientist had a very anomalous position within society, and the artist perhaps had more prestige. Monism, moreover, does not inspire vitality, and dualism demands that difference be overcome. Devin Griffith's "comparative historicism" insists upon the relationality of differences and thus offers a helpful model for rethinking the relation of science to literature in this period.

41. George Rousseau does suggest that Coleridge and Kant felt compelled to reject the modes of explanation of the physiologist (*NA* 86), but in my chapter on Coleridge, I show why this was not the case. See also my "Towards a Physiology of the Romantic Imagination." Haekel shows the continuity of Aristotelian thought in Romanticism, whereby the body was defined in terms of material potentiality (*Soul* chapter 2). Aristotle further defined the soul as both form and substance. He thus shows how history does not support a teleology toward materialism.

42. In Romanticism, "science" moves from the generalized meaning of systematic knowledge acquired by study and mastery to being a particular branch of knowledge. In the 1830s the British Association for the Advancement of Science sought to limit science to natural knowledge (Yeo 33). Markus Iseli remarks that De Quincey noticed a fundamental shift toward specialization within science and industry in 1824 (108). Flanders documents how our notions of creativity are indebted to the Romantics; his study unfortunately neglects scientific creativity, and thus he defines "creativity" in terms of free emotional expression, when in fact feeling was the route to scientific truth.

43. François Jacob captures why biology after genetics was able to embrace teleology scientifically: "for a long time, the biologist treated teleology as a woman he could not do without, but did not care to be seen with in public. The concept of [genetic] programme has made an honest woman of teleology" (9). He qualifies this, however, by reminding us that the genetic program only "sets the limits of action by the environment" (9). Epigenetics demands even stronger qualification, as the surround of the genetic material helps determine whether the gene gets switched on or not. In his "Fragment on God," Percy Shelley rejects deism and the idea of an intelligent designer, insisting that "it is impossible indeed to prescribe limits to learned error, when philosophy relinquishes experience for speculation" (13).

Goldstein argues for a Lucretian counter-spirit with Romantic life sciences, one that

worked to "de-couple professionalizing aesthetics and biology from their shared rhetoric of autonomy, impartiality, and power" (*Sweet Science* 22–23).

44. Kwame Appiah insists that idealization serves to make phenomena intelligible, and that, as such, idealizations are not empirical theories (54). Their import is conceptual, not empirical (56). Cuvier argues that in nature "particular forms and dispositions are created without any apparent view to utility. It seems sufficient that they should be possible, that is to say, that they do not destroy the harmony of the whole" (1: 58). Nature's purposiveness thus mirrors art's imaginative creative spontaneity geared toward the harmony of the whole, and thus the one, biology/physiology/neurology, might tell us something about the other, art.

45. Goldstein cautions that, whereas Kant did not want subjects to become objects, Goethe's "tender empiricism . . . advocates the observer's susceptibility to transformation by the objects under view" (*Sweet Science* 125).

46. Romantic embodiment is tricky business. The period generated enough correlations between mind and body/brain to make an embodied imagination likely, but many were wary of claiming a correlation as identity. In his *Critique of Judgment*, Kant, for instance, wrote that "nor can it be denied that all presentations in us, . . . can in the subject be connected with gratification or pain . . . [I]t cannot even be denied, as Epicurus maintained, gratification and pain are ultimately always of the body, whether they come from imagination or even from the presentations of the understanding" (278). Imagination here is embodied, but the means to this apprehension must be through a triple denial of its role. At issue are the costs of embodiment: possible determinism and mechanism's inability to account for how organic parts relate to wholes. Yet the Romantic emphasis on active perception and vitality as feeling made more permeable the dividing line between brain and world. Jaegwon Kim submits that, for correlation to be scientific, it usually is deduced from more fundamental correlations or laws or shows that correlated phenomena "are collateral effects of a common cause" (105). To the extent that is true, scientific correlation now approaches both identity and causality.

Romanticism anticipates what Barrett calls "constructed emotion" (153), which means that it is not universal and preexisting but rather constructed neurally, socially, and psychologically on the fly (ibid.).

47. Expert on memory and learning Eric Kandel has demonstrated how "creative" our perception really is (*Reductionism* chapter 14). Perception synthesizes a top-down and bottom-up visual processing. The Romantics anticipate ideas of the creativity within perception, thus both attuning them to the costs of a subjective/objective split and making a Kantian approach to things more salient. To be sure, much of this "creativity" is unintended, and accounts for binding (our sense of our perceptions as a unified field, which allows consciousness and a self to appear to us). Whereas our current sense of binding is inwardly directed, the Romantics, in their insistence upon relationality, moved in both outward and inward directions simultaneously.

48. In his recent study of imagination, Stephen Asma argues that the body and the emotions are the true source of imaginative creativity and what he, borrowing from behavioral economist Daniel Kahneman, calls "hot cognition," our ability to make spontaneous choices. The more deliberative cognition is called cold cognition, but this is in his view a minor player with regard to imagination. See chapter 2. Lisa Feldman

Barrett, in *How Emotions Are Made*, also thinks emotions are central to decision making, but she ties them to our sensing and managing of our own bodily energy. One could point to Blakean energy as having anticipated this. Davy in the Notebooks writes, "Pleasure must be modified by pain to produce energy" (HD 21/b, page 8).

49. In fairness to Engell, he does deal with Brown's "chemistry of mind" (168).

50. Robert Mitchell links experimentation with the generation of differences. Yet difference in science cannot always be the ground of meaning that it sometimes is within literature, because some data must be relegated either to the environment or noise. There is also the demand for reproducibility. Enormously suggestive, however, is his point that experimenting with experimentalism "aims—if it can be said to 'aim' at anything—only at facilitating new forms of thought and sensation" (35). I further agree that we should desynonymize experiment and innovation, because that coupling reduces experiment to neoliberal means of capitalism (227), and both experiment and innovation can be destructive. At the same time, we must recognize that the association of innovation with experiment displaces the fantasy of science as merely rote method.

51. Klein adds, "The term 'laboratory' was increasingly used in the eighteenth century, to include, in addition to academic-chemical and pharmaceutical laboratories, workplaces in arsenals, metallurgy (assaying), mints, dye manufactories, porcelain manufactories, distilleries, and perfumeries. More historical studies are necessary to understand the use of the term" (774). On Priestley's laboratory and its contents, see McKie.

52. Ralph O'Connor studies the ways in which writers specializing in geology exploited imaginative techniques like poetic imagery to bring their narratives to life (introduction).

53. Gabriel Trop explains that while Kant's purposiveness is made possible by human reflective judgment, Schelling makes it a part of the "objective structure of nature." See his "Aesthetics of Schelling's Naturphilosophie," 5–7. Of course, "objective" is not without its complications.

54. Reill argues that Humboldt positioned himself very carefully vis à vis *Naturphilosophie* by praising their efforts yet insisting upon the superiority of his own empirical approach, eschewing claims of "internal nature" (239–40).

55. At the 2017 American Comparative Literature Association conference in Utrecht, Gabriel Trop called the problem of *Naturphilosophie* individuation, because it aborts attempts toward the absolute. If nature tends toward individuality, it veers outside normativity. Nature in this view is paradoxically unnatural. Perhaps it might be said that it has the appearance of the unnatural. And yet, for unification to remain a form of intellectual work for *Naturphilosophie* to encourage, difference cannot simply dissolve into unity.

56. Orsted also wrote poetry, which remains radically understudied. James Clerk Maxwell eventually realized that electromagnetism required a new fundamental entity (beyond those required by Newtonian physics), that of electrical charge.

57. Hacking's attention to how science actively cultivates a sense of stability, which he recognizes can make science dead, suggests another reason why the imagination would not be credited within science (41–43).

58. All citations to Blake will be from David Erdman's edition, unless otherwise noted, designated by an E.

59. Holmes's engaging study does not address how this wonder needed to be disciplined into science and art. In his essay "History of Astronomy," Adam Smith comments that the imagination is struck by singularity, but, when the object is grouped among others in the same class, wonder dissipates (13). With regard to astronomy, he suggests that the imagination is "disturbed" when it cannot connect events together (20). Natural philosophy thus underscores the "invisible chains" that connect disparate objects (20).

60. Tallis notes that "it was not science . . . but . . . the scientism of Enlightenment figures such as La Mettrie, Hartley and Laplace" that was the Romantic enemy (12). He further decries the hubris that defined the sciences as lacking human values, urging that science be regarded as part of the humanities (10). John Thelwall agreed, noting "the humanizing pursuits of Intellect and Science" (15). Kandel argues that although the "artistic process is often portrayed as the pure expression of human imagination" (*Reductionism* 4), abstract artists often employed methodologies similar to those of scientists. One might think about how Romantic artists cultivated methods such as Gainsborough's practice of using a six-foot paintbrush so he could see how the viewer might consider his work or Turner's interest in how color might attract attention from the other side of the room. Both art and science resist rote methods. Hacking laments that "descriptions of experimental procedures have long been regimented to make them look as if experiments have much in common" (43), and this makes it more difficult to couple imagination and experiment. Golinski considers how the laboratory's constructions become universal phenomena (*Making Natural Knowledge* 32), perhaps another reason why the scientific imagination does not get credit. Finally, the recent turn within the history of science to the idea of cultures of scientific practice has begun to restore the diversity of scientific acts, which can become wooden in the name of "culture," and even more so under "Romantic culture." Romantic science could not be reduced to experiment. That diversity may finally enable Romantic science to be considered imaginative (though experiments certainly require it) and not just pejoratively so, even as "practices" might imbue imagination with different kinds of material specificity.

61. Steinle thus makes the case for "exploratory experimentation," which he contrasts to theory-driven experiments (*Exploratory Experiments* 312–20).

62. Historicist critics of the imagination include Levinson, Liu, and McGann. In response, a new wave of critics has suggested that Romantic writers on the imagination were far more self-conscious of its limitations than historicists recognized: see Pyle, White, and Whale, among others. Rather than repeat this material here, I cover this ground in my essay on imagination in the *Handbook to Romanticism Studies*. In his *Lectures on Physiology*, William Lawrence did warn against an "unnatural union" between observation and imagination. Like all unnatural unions, he believed this one would be sterile (83).

63. Here's why the line between the material and immaterial was so muddled. In biology, there is no cell theory until the 1830s. In chemistry and physics, the atom does not become real and calculable until 1905. Until scale is fixed and consequences become calculable, materiality lacks precise consequences and thus, one might argue, functions primarily metaphorically, thus leaving the door ajar for spirit. Cauldwell argues that nineteenth-century medical professionals generally considered science and

religion to be separate entities, and as such could have metaphysical commitments, but would defer them within science (27). Kirkby argues for the importance of "spiritual sciences" in the period, including mesmerism. Tristram Wolff quotes Cassirer's point that the difference between nature and culture "is no longer to be bridged through a spiritualization of nature, [as in Cassirer's version of Romanticism], but through a materialization of culture" (621). If Romantic nature hovered between materiality and spirit, culture now hovers between them.

64. Stephen Hales's invention of the pneumatic trough, for instance, enabled the identification of many kinds of different airs (gases), and his work helped Joseph Priestley to discover many gases. Thus, in the period, air becomes multiple kinds of air. See chapter 5 of Trevor Levere, *Transforming Matter*. In Romanticism, moreover, ontology was divided into numerous kinds of essences: M. Kim argues that eighteenth-century chemistry was satisfied with operational essences, and Knight in *Atoms and Elements* argues that Boscovich believes in structural essences (atoms as geometric points and not ontological entities). Our current understanding of essence misses these nuances entirely.

65. Knight argues that while Dalton considered the elements to be composed of irreducibly different atoms, Davy considered the elements to be composed of the same kind of atoms (*Atoms and Elements* 26). To be sure, Coleridge credited Lavoisier for having reduced the "infinite variety of chemical phenomena to the actions, reactions, and interchanges of a few elementary substances" (*PL* 343). My point is that, in Romanticism, polarity generates differences; atmosphere became many gases; there were new kinds of imponderable matter like electromagnetism, heat, and light; Humboldt includes time and space in his catalogue of natural philosophy; and Dalton makes persuasive the case that atoms are not uniform but different.

66. Golinski (*Experimental Self*) attends to how the role of a natural philosopher forced Davy to negotiate his social obligations to benefit society with pure intellect and disinterest. How did a natural philosopher shape the history of objectivity?

67. Whether this abstraction or synthesis is spontaneous, and whether that spontaneity means that any unity is inherent, are two key issues that have bearing on how science is to understand it, if it can at all. Makkreel argues that, for Kant, the imagination is associated with a creative spirit, an enlivening power that is a feeling of vitality. By associating this power with *Zusammenhängend*, Makkreel submits that Kant insists on the inherent unity of it: "What is felt through the interior sense already coheres and hangs together" (97). However, so long as the imagination's powers stand outside rules, science must be wary of its contributions. Hence, Kant calls "the association of presentations . . . an empirical basis of reproduction according to rules" (*CPR* A121).

68. One of those limits, for some, could be the limits of experience itself. Orsted, for instance, insisted that "experience can only teach us what is but not necessarily what must be" (*Fundamentals of the Metaphysics of Nature* 46). Here he separates the "is" from the "ought."

69. Asma argues that there are two imaginations, an emotional one with a long evolutionary history and a newer, more rational one. He thinks the older, emotional one is the more powerful of the two, as it accounts for our ability to successfully improvise and our "cognitive fluidity" (160–63).

70. Beddoes suggests that, in the absence of brain lesions, it might be possible to account for insanity by studying the individual's biochemistry (Hunter and Malcalpine 578). When one level does not yield correlations, one can go to another level of analysis.

71. For an overview of the imagination's links to insanity and madness, see Hunter and Malcalpine. Their collection of books profiled in *Three Hundred Years* is housed at Cambridge University Library.

72. See Beiser on *Bildung*, *Imperative*, 88–105.

73. Thanks to April Shelford for pointing me to this essay.

74. Asma leverages association over algorithm to argue that computational understandings of the mind have gotten it wrong. In this, perhaps the Romantic interest in association, going so far as to consider it a law, offers some current enlightenment.

75. Scottish poet James Beattie, in *Dissertations moral and critical*, insisted that since no one knew where the imagination was in the brain nor how it was connected, "neither can we explain these faculties, by experiments made upon matter; or in any other way, than by attending to what passes in our minds" (1: 3). Beattie goes on to refute the idea that the impressions of imagination are fainter than those of memory (1: 6–7).

76. M. Kim, for example, shows how eighteenth-century chemistry had operational over ontological criteria of chemical stability (146).

77. See also Kant, *CJ* 379. Müller-Wille and Rheinberger note that causality is complicated by prevailing Aristotelian theories of it that understood cause and effect "as simultaneous and contiguous events. Causes did not precede their effects, but shared points of contact, so to speak, with their effects" (23).

78. Appiah reminds us that "as if" arguments are delimited to specific contexts (16) and in this way highlights the modesty within strands of idealism.

79. Robert Richards cautions that even scientists had trouble sticking to the distinction between regulative and constitutive reasoning (*Conception* 227–29). In his "Critique of Teleological Judgment" (within the *CJ*), Kant does distinguish between formal purposiveness, which would be regulative, and "material, objective purposiveness," which is constitutive. Constitutive purposiveness considers not just the product's form but also the form's necessity. Necessity has two criteria to meet: "The possibility of its parts . . . must depend on their relation to the whole," and "the parts of the thing combine into the unity of a whole because they are reciprocally cause and effect of their form" (*CJ* 373). We should note how high the bar is for showing constitutive purposiveness, without which the imagination would have too much freedom. In his *Philosophy of Material Nature*, Kant acknowledged the importance of Hume's critique of causality for showing how reason relied upon "bastard[s] of imagination, impregnated by experience": "We cannot at all see why, in consequence of the existence of one thing, another must necessarily exist" (258). Nassar explains that Kant turns to teleology to explain causality because mechanism is insufficient (60).

80. Here's Faraday on imponderable matter and materiality: "Imponderable substances are such as have no appreciable weight, and do not evince properties belonging to materiality. They cannot be accumulated in masses, or confined, and we can only ascertain their effects when in a transient state" ("Lectures on Chemistry," 113). Faraday's claim of the lack of evident material properties, however, is not a claim of

immateriality. Coleridge provides a different wrinkle: according to Coburn, he claims that "ponderable substances . . . appear by weight" and thus have a "body," whereas "that which appears, but not by weight, or imponderable substance, is Matter" (*PL* 370). Yet, according to the British Library manuscript Egerton MS 3057, an unknown attendee recorded, "That which is actually substance and in chemistry would be called ponderable is in Philosophy body. That which is without perceptible weight [word illegible] termed the imponderable is Matter such as the Sunshine" (28). "Perceptible" is an important difference, because it implies that future technologies can make it perceptible. The manuscript version makes more sense because it stipulates sunshine to be an example of imponderable matter as opposed to requiring all matter to be imponderable.

81. Einstein credits imagination for natural laws, writing, "Not only are the fundamental laws the result of an act of imagination that cannot be controlled, but so are their ingredients, the ideas derived from those laws" (14: 725). Of note is Einstein's insistence that the act of imagination cannot be controlled.

82. As biologist Michel Morange points out, fixed definitions of life are not possible because life is capable of generating new properties (152).

83. Cuvier cites Kant in *Lectures on Comparative Anatomy* (1: 6).

84. Asma argues that the imagination's greatest strength is its improvisatory, playful nature (73–83). In this view, the very control of it risks the loss of its power to think outside the box.

85. I am indebted here to conversations with Stefani Engelstein about Goethe.

86. Faraday brackets his observations with phenomena when he argues, "Though effects may sometimes occur, dependent on the compound nature of what we call simple substances, yet it is better to own our ignorance of these phenomena, if we cannot by their means ascertain satisfactorily the true circumstances of the case, than to forge an hypothesis which shall in accounting for a single instance give birth to a thousand chimera elsewhere" ("Lectures on Chemistry" 157).

87. Feelings thus underwrite the continuity between visual perception and the visionary imagination that Alan Richardson traces in his *The Neural Sublime* (46–48). Vickers argues that Coleridge turned to touch over visual ideas because "visual ideas without tangible force results in a lack of vitality" (124).

88. Dear traces Aristotle's idea of "reasoned facts" as he understood that the goal of facts was explanation (*Revolutionizing the Sciences* 4–7). Alexander Schlutz argues that, for Kant, "rational subjectivity is thus simultaneously dependent upon and constructed in opposition to the imagination, and the resulting ambivalence is one of the fundamental conditions of modern subjectivity" (7). For German idealists like Schelling, by contrast, "the representational power of imagination [was] the indispensable precondition for the unity of self-consciousness" (9). I here consider how science as phenomenology helped cope with the gap between imagination and reason.

89. In his "Notebook on Education and On Nitric Oxide, circa 1800," Davy has "Hints Towards a Treatise to be entitled Observations on Education and on the Formation of the Human Intellect Designed for the Use of Parents and Instructors." Here, Davy insists that perceptive existence begins with the feelings of the infant before birth. "The spark of life has been kindled by a number of feelings perceived during the mysterious formation of organs, a number of impressions of touch, of taste of smell &

perhaps of sound" (3). He later in this notebook emphasizes that feelings are the basis of associations: "His feelings are connected with aggregates & consequently referred to aggregates as to causes" (17).

90. Jan Golinski comments that, within the Royal Society, "communal norms seemed to have exerted little restraint. Instead, they served as rhetorical weapons" (*Making Natural Knowledge* 55). Jonathan Smith argues that Wordsworth, in declaring poetry's superiority over science, is trying to thread a needle between praise of Bacon and chastising his followers for being too literal in their interpretation of him (53). He goes on to consider Wordsworth's use of "poetic induction."

91. William Smith reads Hunt rhetorically; after he seems to denigrate science, he invokes botany (49–50).

92. Kant in his *Metaphysical Foundations of Natural Science* insisted that proper science requires a pure part "in which the apodictic certainty of its first principles is founded, and in which the possibility of physical objects is guaranteed by a construction of its concept in pure intuition" (Pulte 102). In his manuscript notebook treating his 1827 "Lectures on the Philosophy and Practice of Chemical Manipulation," Faraday announces that he will impart to his students "beautiful facts" (1), reminding us that aesthetics and science went hand in hand ("Notes for his Lectures"). Aesthetics can have scientific use, as, for example, any symmetry can shortcut the calculations that need to be made. He also describes many "beautiful experiments," ascribing to them a simplicity and elegance.

93. An added complication: Mi Gyung Kim charts how Enlightenment chemical affinity tables are analyzed by historians of chemistry as both fact and theory, and she cites Keller's recognition that theory itself could mean "the analysis of a set of facts in their relation to one another" or the "general or abstract principles of a body of fact" (141–43).

94. Orsted argued that "in the writings of good chemists who describe their works in great detail, phenomena are often reported which in Winterl's work belong to a system of facts but which are presented there merely as rare phenomena originating from accidental causes" ("Chemistry of the Nineteenth Century" 124). In this view, phenomena are crucial for chemists to record. Good chemists allow certain phenomena to remain accidents. Great chemists like Winterl recognize that what looks like accident nonetheless indicates systems of facts. This insistence upon system will not allow facts alone the power to immunize the imagination from error.

95. At one point during his chemical lectures, Faraday declaimed, "I will point out the history of this substance [chlorine] as an answer to those who are in the habit of saying to every new fact what is its use. Dr. Franklin says to such what is the use of an infant? The answer of the experimentalist would be to endeavor to make it useful" ("Lectures on Chemistry" 175).

96. In his 1844 preface to the English translation of his *Elements of Physiophilosophy*, Oken warned of the dangers of "blindly and laboriously groping about in the dense labyrinth of facts" (ix).

97. On sensibility and its importance to Enlightenment science in France, see Riskin. Nicolson's pioneering *Science and Imagination* examined the effect of scientific technology on the literary imagination. On the links between colonialism and science, see Fulford, Lee, and Kitson; and Bewell, *Romanticism and Colonial Disease* and

Natures in Translation. In a 1788 essay, Coleridge argued, "If their [children's] reason is grown stronger, their Passions and Appetites are likewise grown proportionally more powerful" ("Liber Aureus" Ashley 3506 (3), page 5). He does not see an inverse relationship between the growth of reason and of passion.

98. Hanna argues that Kant's insistence upon the primacy of human nature provides an important alternative to scientific naturalism, giving the sciences a practical orientation: "Nothing can be knowable in the exact sciences that ultimately contradicts the real possibility of human persons and their capacity for autonomy" (33–34).

99. Consider as well how often Davy insists on "form" or "appearance" or "phenomena" in his published researches on chemistry. Likewise, his "Lectures on Chemistry" are replete with "instances," and he reflects upon when those instances can and cannot support generalizations ("Electrochemistry," 85–87, 88, 89).

100. As Jonathan Smith perceptively comments, despite the turn away from science and art as two cultures and toward one culture, there is lurking within it a sense of "a fundamental difference between science and literature" (5). His study charts the rising and falling fortunes of Baconianism in the nineteenth century and as science defines itself by its distance to sense impressions.

101. Barrett argues that "believing is feeling" (78). Insisting that emotions are constructed in the moment based on a lifetime of experiences, Barrett shows how emotions facilitate our predictions about the world, which shape our constructions of it. With emotions, she argues there can be no accuracy; instead, there is only social consensus (140). Barrett's work undermines the theory that universal emotions exist and thus makes Romantic phenomenality and Kant's interventions all the more salient.

102. Abrams overestimates the differences between scientific scrutiny and poetry in *The Mirror and the Lamp* (303–12). Steinle argues that, unlike Kant, Ampère thought that aspects of the noumenal could be scientifically known (*Exploratory Experiments* 79).

103. Jocelyn Holland treats Goethe's *Urpflänze* as an "imagined plant, if conceived according to the correct model of generation and organization, to have the same 'truth' and 'necessity' as a living one" (*German Romanticism* 20). The problem of observing and describing metamorphosis leads Goethe to recognize how these acts are fundamentally creative and thus poetic language can contribute to science (33). See also Wellmann, who argues that Goethe uses the distich as an in-between space which fuses biologism and aestheticism (132–33).

104. Terada worries about the evasiveness of this deferral (*Looking Away* 16). If phenomenality gave a sense that one was in touch with the universal, it could be associated with positive feelings, which Terada neglects. Stengers argues that "the sciences do not owe their existence to the disqualification, with which they are identified, of so-called 'pre-scientific,' or nonrational, knowledge" (*Cosmopolitics I* 11).

105. Rajan in "First Outline of a System of Theory: Schelling and the Margins of Philosophy" traces Schelling's anxiety that absolute knowledge would overturn the requirements for a transcendental knowledge (315), and this meant that the contingency of nature would never be reconciled with freedom. Beiser argues that Romantic skepticism had a more positive side: the experience of art could allow an encounter

with the absolute, and although this experience did not necessarily demonstrate anything, at the same time, the aesthetic experience itself could not be refuted (*German Idealism* 373).

106. Tyndall embraces the speculative powers of imagination, exhorting his readers to come to terms with waves as a structuring principle of sound and light. He warns that the imagination will be productive to those who know its liberties without abusing them (31). Schaffer moves "discovery" outside of the mind of the heroic scientist and toward collective practices, and this turn to collective practices further explains why the imagination has fallen out of favor.

107. In *Essays on Physiognomy*, Lavater credited imagination with futurity: "Perhaps even futurity is comprehended in the circle of its inexplicable activity" (3: 185). In his experiments trying to determine the differences if any between animal matter and ordinary matter, Abernethy invoked empirical futurity and science as collective labor: "If related experiments should be considered insufficient to prove these doctrines, I heartily hope it may excite others to further investigation" (*Surgical and Physiological Essays* 106). Isabelle Stengers argues that "laws" and experimental staging allows science to smuggle in the "far horizon of scientific research" into current observations (*Cosmopolitics I* 89–91). Hans-Jorg Rheinberger shows how experiment relies upon what he calls fuzzy concepts and fluctuating objects (154–59).

108. For a strong overview of scientific metaphor, see Bono. His framing of scientific metaphor as a "medium of exchange" (72) that enables science to control metaphor is helpful.

109. Coleridge refers to scientific predictions as "prophetic powers" (*PL* 360).

110. In *The Art of Scientific Investigation*, Beveridge notes that "it is impossible to create ideas or control their creation" (74). Thus, he recommends allowing the imagination to wander freely (75). To the extent that the imagination's role has been downplayed within accounts of scientific method, it is because it is difficult to control. Valdés and Guyon argue that educated imagination works in poetry to ask "as if" and "what if" in physics (29).

111. I am thinking here of the ways in which Theresa Kelley in *Clandestine Marriage* shows Romantic understanding of plants to act more like figures that challenge the taxonomies botany would impose upon them.

112. See also Kramnick, who shows how physics defined actions and objects and how mental action had to define actions and objects in relation to those definitions.

113. On *Gefühl*, see Henderson on Novalis, 154–55.

114. Laura Crouch made this case convincingly in 1965.

115. However, Joanna Picciotto argues that Bacon shifted the primal scene of discovery from Eve's eating of the fruit to Adam's naming of the animals and in this way redeemed curiosity (3). Martin Jay argues that Bacon replaced Montaigne's more open notion of experience with an idea of experience closer to scientific experiment (28–31).

116. Davy alludes to Bacon's idols when he claims that "we will go my friend together to combat in the cause of truth, to destroy the gigantic Idol of man language connected with feelings which like another Moloch has thousands of innocent victims daily immolated on his altars" ("Notebook on Education and On Nitric Oxide, circa 1800" 21). This passage is curiously orphaned. Although it would logically relate to the

material on page 20, Davy has turned the notebook upside down. Where the remarks on the previous pages are triumphant, these remarks are, by contrast, grim. The handwriting also looks hastier, less precise.

117. Steven Goldsmith argues that for Blake the gap between reason and imagination was the locus of the sublime agitation; the very invocation of judgment to heal the gap becomes a site of difference that can be harnessed for social disruption. See chapter 1 especially.

118. Orsted dismissed Kant's rejection of the infinite divisibility of matter on the grounds that "the conception of infinitely small parts is merely an idea which reason has thought up in order to arrive at a limit, but nothing like it can ever be found in any possible experience" (*Metaphysics of Nature* 59).

119. Damrosch recounts Blake's sense of the ancillary nature of proof. When Thomas Taylor was tutoring Blake in Euclid, Blake interrupted his demonstration with "what's the use of going to prove it? Why, I see with my eyes that it is so, and do not require any proof to make it clearer" (126).

120. Exceptions here include Massey and Noel Jackson. Massey credits Keats with thinking about "the provisional nature of thought" (187). William Babington, Keats's chemistry teacher, in his "Introduction to Natural Philosophy" equated imagination with wild hypotheses. He exclaimed, "You may imagine all the matter in the solar system to have formed originally one immense chaos, & portions of this chaos projected by some might arm, to constitute the several planets" (*Lectures on Chemistry*). He added, "This wild hypothesis is not only encumbered with difficulties but pressed with contradictions."

121. In "Language, Discourse, and Science," Golinski suggests that a hermeneutic approach to metaphor within science allows them "to be read as devices for the transfer of meaning between different disciplines, or between science and general culture" (115).

122. Morange, a molecular biologist, argues that life is an emergent phenomena that occurs after the chance conjunction of three phenomena: "the appearance of molecular structures, a series of intense chemical exchanges, and the autonomous capacity to reproduce" (146). Life is so difficult to reduce because it depends upon systematic relationships; hence the need to be cognizant of one's role as interpreter. The object of interpretation is thus a form or appearance.

123. Psychiatrist Arnold Modell links the imagination to the biology of metaphor. He writes, "As a mode of cognition, metaphor is doubly embodied, first, as an unconscious neural process and, second, in that metaphors are generated from bodily feelings, so that it is possible to speak of the corporeal imagination" (27).

124. For more here, see Skolnick and Bloom. Physician, botanist, and patron of Blake, Robert Thornton, noted in his *Medical Extracts* that "the man of imagination makes a great an *artificial* happiness, by the pleasure of altering and combining" (2: 306).

125. Golinski calls Davy a "man of science" instead of a "scientist" on the grounds that "scientist" as professional identity is anachronistic. Yet this is to split hairs rather finely: Is "man of science" that much of an improvement? Suggestive is his thesis that making one's living through science required creativity and resourcefulness. He thus shows how Davy fashions his identity in multiple ways. As a philosophical chemist, he claimed the authority of theory over those who pursued the chemical arts (*Experimental Self* 126).

126. See the TED Talk by Laura J. Snyder, "The Philosophical Breakfast Club." Richard Yeo reminds us that "scientist" did not catch on until the close of the nineteenth century, because men of science like Faraday "preferred to think of their work as part of broader philosophical, theological and moral concerns" (5). Romantic science insisted upon those broader concerns, and thus "scientist" should not be ruled as inappropriate. Whewell, for example, turned to "scientist" to unite "astronomers, chemists, geologist, and botanists" in a common enterprise at a moment when science turns to specialization (Yeo 111).

127. See also Georg Braungart, "The Poetics of Nature." Geology, Braungart argues, dealt a huge blow to the human ego, because it demonstrated the relative insignificance of human history that had to be overcome by the imagination (28).

128. Goethe warns that "we should not try through experiments to directly prove something or to confirm a theory. For at this pass—the transition from experiment to judgment, from knowledge to application—lie in wait all our inner enemies: imaginative powers that lift us on our wings to heights, while letting us believe we have our feet on the ground" ("Experiment as Mediator" 20).

129. Porter demonstrates how textual archives provide an inductive database in Romanticism, substituting for reproducible experiments (62–64).

130. Kearney warns of the imagination's "imminent demise" because postmodernism undermines the modernist belief in the image as an authentic expression (3). Among others, Jennifer Ford, Alan Richardson, Lisa Ann Robertson, Ute Berns, and Yasmin Solomonescu have written recently on the Romantic imagination, but, with the exception of Richardson, the term has become localized.

131. See also Markman, Klein, and Suhr.

CHAPTER 1: Imagining Dynamic Matter

1. Ault reminds us that Newton had "a deep intuition for the limits of a purely mechanical interpretation of nature" (*Visionary Physics* 8). As he shows, the possibilities of dynamism lurk within Newton's system. Although Newton's atoms are immutable particles, his fluxional calculus provides ambiguity (6).

2. Citations to *Prometheus Unbound* are from Reiman and Fraistat's *Shelley's Poetry and Prose*. Quotations from the preface will be cited by page numbers. Quotations from the poem will be cited by act; when relevant, scene; and then line number.

3. See R. Mitchell 146.

4. In his January 1844 *Experimental Researches in Electricity*, Faraday wrote, "The word atom, which can never be used without involving much that is purely hypothetical, is often intended to be used to express a simple fact; but good as the intention is, I have not yet found a mind that did habitually separate it from its accompanying temptations" (2: 285). Coleridge accuses the ancient Greek materialists responsible for the theory of atoms of at least four fictions: the atom itself being the first; the second being atoms of various figures; the third, round atoms consisting of elements of fire; and the last, fire as the principle of thinking. See *PL* 353.

5. Hanna reminds us that, for Kant, "every self-conscious human cognizer has direct veridical perceptual or observational access to some actual macrophysical dynamic material individual substances" (29). His overall thesis is that Kant's metaphysics is his ethics and that Kant's metaphysics is thoroughly anthropocentric and

practical. My inspirations here are Quentin Meillassoux, who argues that "the virtue of transcendentalism does not lie in rendering realism illusory, but in rendering it astonishing, i.e., apparently unthinkable, yet true, and hence eminently problematic" (27), and Rei Terada. Science, of course, works to make astonishment thinkable. I part company with Meillassoux when he seeks to get rid of Kantian correlationalism, because that goal obstructs rather than clarifies the Romantic project. That Meillassoux turns to an empirical object—the prehuman fossil—to take down Kant, who is interested in the conditions of knowledge that make knowledge possible, violates Kant's premises. In *Looking Away*, Terada questions why appearance is associated with dissatisfaction, when appearance mandates reflexivity.

6. Just because something is thinkable does not entail it is really possible (J. Kim 39). Kant argues that things in and of themselves while unknowable are thinkable, and this gap perhaps provides the ground of what Richard Holmes calls wonder and Meillassoux names astonishment. This gap further complicates Shelley's Platonism, where the imaginative is coextensive with the noumenal but does not directly get to it. In his *Opus Postumum*, Kant sought to overcome what he saw as the limits of the *Metaphysical Foundations*: "These furnish no specifically determined, empirical properties, and one can imagine no specific [forces], of which one could know whether they exist in nature" (*OP* 22: 282). M. Friedman shows how dynamism enabled Kant to envision a science of chemistry once all forces specific to chemical interactions were documented (*Kant's Metaphysical Foundations* 60–61).

7. Janelle Schwartz recognizes how speculations concerning material nature carry irony, as "all discussions of materialism necessarily do" (43).

8. Janice Cauldwell's concept of Romantic materialism, though it does not deal with dynamism, is helpful. She submits that "Romantic materialism accepted disjunctions between two ways of knowing: science and religion, and this called for an 'interpretative method' that toggled back and forth between imagination and empirical evidence" (1).

9. In his *Philosophy of Material Nature*, Kant defines thinking as "uniting representations in a consciousness" (305). Thinking then is proximate to the imagination's unifications of the manifold of presentations but not identical to it.

10. I thank Adam Komisarik for helping me to articulate this position.

11. On the pervasive problem of thinking matter, see Yolton, who demonstrates how Locke and others had to take seriously the possibility of a matter that could think. Current forms of thinking about matter from the perspective of information—it from bit—and the turn to plant cognition give this debate renewed salience.

12. See Jane Bennett, *Vibrant Matter: A Political Ecology of Things* and the essays by various hands in Diane Coole and Samantha Frost, eds., *New Materialisms*. When vitalism claims that life is beyond the reach of naturalistic explanation, it mistakes current limitations for future ones. In *Sweet Science*, Amanda Jo Goldstein argues for a continuum between the physical and figuration in Romanticism; where she aligns herself with Lucretius, I turn to Kant.

13. Jacob suggests that biology took a turn toward force as well because it might account for how living matter changes form and moves (94).

14. Newton's primitive particles bore no direct relation to chemical observables. By connecting the term "atom" to the "least particles of a chemical element," John Dalton

enabled the properties of atoms to be inferred from chemical experiments (Thackray 39). One reason why dynamism took off in chemistry was Louis Lemery's development of affinity, "a theory domain of chemical operations rather than of substances" (M. Kim 121).

15. Knight argues that "'dynamical' about 1800 implied a view of the world in which phenomena were to be described in terms of forces" ("Physical Sciences" 60). J. Edwards highlights the epistemological difficulties with corpuscules (105). I thank Charis Anastopolous and Trevor Levere for their e-mail exchanges with me to help me grapple with the intricacies of the very vexed term "dynamism." Under dynamism, forces can be added to matter or be matter; forces can be passive or active, mechanical or vital. The Romantic interest in matter as force allows them to make matter proximate to vitality. Jammer considers dynamics to have led to a dead end, but string theory, supersymmetry, and perhaps even the interactions of the Higgs boson may make its obituary premature. My physicist colleague Nathan Harshman cautions me that the Higgs does not qualify under dynamism because its interactions are about inertia, not acceleration, and no dynamic theory of movement is necessary because movement is a frame of reference problem. In the Romantic period, however, dynamism emphasized the forces of matter, and the symptom of forces was movement. Since the origin of this movement was often thought to be God, the Romantics could sideline the frame of reference problem, since to have one would be to impose limits on God. Harré elucidates the key differences between atomism and dynamism (12–15).

16. Isabelle Stengers reads Diderot's egg, the one with the power to overthrow all theology, as the one forcing D'Alembert to accept that the practices producing his own conception of matter were irrelevant ("Wondering about Materialism" 378).

17. Kant initially postulates a "force-shell atom theory of matter" but rejects atomism in his 1786 *Metaphysical Foundations*. Knight argues that William Hyde Wollaston's 1808 analysis of oxalates "forced the chemical world to take the atomic theory, or at least the law of multiple proportions seriously" but concedes that Wollaston allowed atomic weights to be treated as "mere mathematical ratios" (*Atoms and Elements* 23).

18. The locus classicus of the argument for an essential tension between Romanticism and consciousness is the essay collection of that title, edited by Harold Bloom.

19. References to Blake's *Four Zoas* are to the Erdman standard edition, by the night, the Erdman page, and then the line numbers.

20. Somerville's *On the Connection of the Physical Sciences* was inspired by these recently discovered unities, which "simplified the laws of nature" (preface). She would go on to insist that heat, light, magnetism, and electricity all referred to the same agent. Somerville knew Faraday and his work well.

21. John Yolton argues that when matter becomes force and acquires the ability to be the source of causality, "immaterialism had, one might be tempted to say, become a property of matter itself" (204).

22. Charles Altieri has recently suggested that "it is difficult not to conclude that shorn of its enabling metaphysical oppositions, materialism cannot do significant philosophical work but functions instead to mark a critic's political allegiances" (80). Likewise, in "A Motion," Marjorie Levinson argues that materiality too often substitutes for intellectual arguments. In order for my study of Romantic matter not to fall

into these traps, I must constantly ask what is the intellectual work that I want materialism do. The dynamism of matter in the Romantic period makes it an ally against tyranny, since control and power are ironized in a world of dynamic matter. Yet it does not undo that tyranny: for one, that irony needs to be perceived. For another, the action of matter is the necessary backdrop against which human action can be measured.

23. See Kramnick.

24. For an analysis of Newton's ideas of force, see Jammer (chapter 7). He contends, "Force, for Newton, was a concept given a priori, intuitively, and ultimately in analogy to human muscular force" (124). Ault comments that Newton's disciples interpreted his forces either physically or spiritually (*Visionary Physics*, 15). He also suggests that Newton's admittedly hypothetical ether was an attempt to think about the dynamic and continuous forces.

25. Onno Oerlemans thinks about the ways in which Romanticism "transcends into materiality" (29), and I enlist her as an ally. Janet Radcliffe Richards reminds us that neither immateriality nor indeterminism offer free will. Indeterminism, she submits, offers no one responsibility (140). Although recent critics have underscored Romanticism's dark side, Romantic scientists could be quite optimistic: hence, Davy highlighted that "the process of fusing & working with metals were the first phenomena that proved to human beings that they were not the impotent slaves of blind & unascertainable laws existing in their connected impressions. They exhibited to them the mightiness of their powers, they taught them that volition was the characteristic of man" ("Notebook on Education and On Nitric Oxide, circa 1800," page 19).

26. Modiano notes that Coleridge saw as a key limit of *Naturphilosophie* the tendency to "ascribe physical causes to spiritual activities, that in their attempt to locate the one dynamic power at the root of all phenomena of nature, they confused ideal forces with material substances" (150). My point in Kant at least is that the insistence upon appearance prevents that very collapse, since one was not making ontological claims. The Romantic turn to imagination in order to conceptualize matter, moreover, helped to control anxieties about the denigration of spirit.

27. John Dalton likewise dismissed the idea of one kind of matter as imagination. "It has been imagined by some philosophers that all matter, however unlike, is probably the same thing . . . We ought, however to avail ourselves of every means to reduce the numbers of bodies or principles of this appearance as much as possible" (cited in Knight, *Atoms and Elements* 33).

28. Unlike Davy and Faraday, Schelling thought that intuition was "the highest element in our knowledge" (173). And unlike Kant, who thought forces were the basic concept, Schelling thought Kant's dynamism was insufficiently dynamic because, by beginning with forces, Kant is beginning with something extended, rather than with the fundamental activities of nature itself (Beiser, *German Idealism* 531).

29. Schelling, for example, insists that the "natural laws of reciprocal attraction and repulsion" are an "assumption" (143).

30. Freud later based his concept of the id on the concept of physical energy, derived from force.

31. Key histories of matter in the Romantic period include J. Edwards; Riskin; Levere, *Affinity*; Kramnick; Harman; Modiano; Knight, *Atoms and Elements*; Thackray; M. Kim; Yolton; Ruston, *Creating Romanticism*; and Schofield, *Mechanism*. For a

playful juxtaposition of quantum mechanics to Romantic poetry, see Mark Lussier, *Romantic Dynamics*. I find suggestive his claim that Romantic poetry thematizes dynamism "to complexify purely mechanical visions of inner and outer phenomena, allowing the term to apply equally to the motion or movement of mind and matter" (16–17). Plotnitsky argues that Shelley had a complementary understanding of matter insofar as he thinks of it simultaneously as particle and wave. Grabo pointed out long ago that Shelley's theory of matter seemed to be electrical and "difficult to reconcile with any conception of 'solid' matter" (141). For a suggestive reading of causality as aesthetic from the standpoint of object oriented ontology, see Morton. He argues that causality lies in the realm between objects.

32. For Kant, in order for human beings to be free, they must have access to an agency beyond mere mechanism, beyond the mere laws of physics. The laws of physics thereby form the necessary backdrop against which to measure human freedom.

33. Bensaude-Vincent underscores the complexities of atomism in chemistry (204–05). In his *Philosophical Lectures*, Coleridge wrote, "I do not look on Materialism, on the doctrine of atoms, as philosophy at all inasmuch as it is pure assumption" (106).

34. Haekel (*Soul*) shows how vitalism moves from political radicalism to orthodoxy in the period, and hence its relation to materialism is perforce complex.

35. Popper argues, "These marvelously imaginative and bold conjectures or 'anticipations' of ours are carefully and soberly controlled by systematic tests" (152–53).

36. Schelling argues that force "is a mere concept of the understanding, and hence something that cannot, directly, be any sort of object of intuition" (182).

37. The original French reads: "Mais, c'est la force (qui est la cause du mouvement) qui existe véritablement, ainsi outré hors de masse, de la figure et de leur changement (qui est le mouvement) il y a quelque autre chose dans la nature corporelle: savoir la force" (*Leibniz and Dynamics* 130). Engell notes that, unlike Spinoza, who "sabotaged the imagination because it assumed the static identity of all things as God," Leibniz stressed the active discovering force of imagination (26).

38. See Donald Rutherford, 159–60. Jammer informs us that it is our concept of energy that Leibniz refers to as force (166).

39. Davy has "the Unknown" credit Boscovich for supposing "points [as] possessing weight and attractive and repulsive powers" (*Consolations* 9: 388).

40. Hankins notes Boscovich denied vis viva also because it smacked of Spinozism (292). Knight reminds us that Boscovich's atom was thought to be too theoretical. By 1813, Davy was a fully converted Boscovichean (*Atoms and Elements* 39).

41. Levere cautions that Boscovich used the term "vis," which Levere argues is "power," not force (*Affinity* 13). Child translates "vis" as "force."

42. Boscovich later writes, "I show that the law is nowhere exactly in conformity with a ratio of this sort, unless we add explanations that are merely imaginative" (13). "Imaginative" here brackets the claim as a form of explanation, not a form of ontology. In section 134, he again invokes the aid of geometry, asking his readers to "imagine something that is perfectly plane and continuous" (58).

43. I have consulted Kant's *Metaphysische Anfangsgrunde der Naturwissenschaft* for the original German. Barry Gower argues that Kant made the dynamic theory of matter well known, at least among German scientists (321).

44. I have adopted Pollok's translation here ("Fabricating a World" 97). Important

studies of Kant's understanding of matter include essays by Pollok; M. Friedman; Watkins; Kitcher; Modiano; and Hanna. Key studies of Kant's notion of the imagination include those by Makkreel; Kneller; and Schlutz. Kneller's fine study, in particular, makes the case for Kant's Romanticism. Modiano charts Coleridge's ambivalence to Kant, and the poet lambasted Kant for having confused the unknown cause of the phenomenon with the phenomenon itself (156). Yet he praised Kant for "construction of matter by two powers" (157).

On Blake's understanding of imagination as an inverse homology to Newton's, see Ault. Like Blake, however, Newton was disturbed by the self-sufficiency of mechanism (Ault, *Visionary Physics* 8). Because of the immense practical success of Newton's theories, his acolytes were not bothered by the theology underpinning them.

45. Coleridge links fantasia with the active powers of the mind and imagination with "passive perception" (*BL* 1: 99). Schlutz notes that for Kant, while *Einbildungskraft* stands in relation to our rational faculties, *Phantasie* produces its mental images involuntarily, thus making it outside reason (111). Yet by having the spontaneity of the production of images mirror laws of the development of thought, the imagination's automaticity did not have to result in its exile from rationality. For this view, see Makkreel; and Mensch.

46. J. Edwards cautions that although the standard history of Kant's positions with regard to matter assigns a clear break between the earlier corpuscular accounts of matter and the later dynamical accounts of it, force was always an important influence. See chapter 7. Thomas Reid dismissed "Epicurius's atoms," claiming they "dance about in emptiness" (*Inquiry* 31).

47. Pollok suggests, "One might wonder whether Kant's dynamism and the basic forces it assumes involves at least as much 'fantasy' as mechanism with its conception of full and empty space" ("Fabricating a World" 97). I thank Konstantin Pollok for his e-mail exchanges with me about Kant's theory of matter. I am grateful to Alex Burchfield for his insights into the nuances of Kant's German.

48. Modiano reminds us that Coleridge accepted Kant's argument that the fundamental forces could not be explained because they were beyond experience (155).

49. In the abstracts of his Friday Evening Discourses at the Royal Institution, Faraday sought to correct the public misapprehension that Brownian motion had proved vitalism: "Mr. Brown by no means intended to say or even had said, that the motion was an indication of vitality" ("Abstracts" F/13/F(2), page 72). Einstein was able to imagine Brownian motion as evidence for atoms. Since objects in a fluid have a jittery motion that could be seen, one could figure out how much motion there should be, and this would entail the size of the atoms (Feinberg 29).

50. Schofield briefly discusses the influence of Unitarianism on Priestley's approach to matter (*Enlightenment of Joseph Priestley* 184).

51. The price paid for the loss of human free will is that human beings become an agent of the divine (*Disquisitions* 1:43). For Priestley, this is a bargain.

52. Priestley argues, "How unintelligibly are persons reduced to talk, when they quit the road of common sense, forming their systems not on facts and appearances, but from imagination" (*Disquisitions* 1: 78). Imagination is here aligned against common sense; somewhat surprising is that common sense includes attention to "appearances." Ault suggests that Newton at least, since God worked through appear-

ances, does not deal with the possibility that God works through deception (25). Later, Priestley warns that giving scope to the imagination without restraint is dangerous (1: 119). Still later, he warns that "our ascribing impenetrability to matter might make us imagine, that we had some kind of idea of its substance, though this was fallacious" (1: 139). Engell reminds us that in Priestley's *Lectures on Oratory*, the imagination "assumes a broader and more active role in 'the internal agitation' of the mind" (73). Jean-Jacques Rousseau insisted that "the word substance . . . is at bottom the greatest of abstractions" (256).

53. Coleridge's response was to mock Priestley for having "stript matter of all its material properties; . . . when we expected to find a body, behold! We had nothing but its ghost! the apparition of a defunct substance!" (*BL* 1: 136). Yet Coleridge misses Priestley's careful bracketing of ontological claims. On essentialism as a strategy, see Diana Fuss, *Essentially Speaking*.

54. See Pheng Cheah, who argues that deconstruction insists upon a materiality without matter because matter is equated with presence.

55. Ruston shows Davy's interest in a material sublime (*Creating Romanticism* chapter 4). "For Coleridge, the imagination is . . . such [a] modifying principle and the process of sublimation is used to describe its power to transform" (135).

56. Levere (*Affinity*) cautions that Davy uses Newtonian corpuscles, but "these were frequently supplanted by all-pervasive forces without material centres" (29). Davy wrote to Coleridge that, despite his absence, "you will live with me . . . as an imagination winged with fire inspiriting & rejoicing" ("Letters" March 1804). I thank Wahida Amin (Nas) for her help in deciphering Davy's quite wretched handwriting.

57. Coleridge's notes on these lectures are published in *Notebooks* (1: entry 1098).

58. Davy denounces individuals with "religious emotions . . . [who] imagine [them] sel[ves] to be the peculiar favorite of the Deity. The vivid appearances of the ideas and the wild and uncommon mode of their Association dispose him to believe them" ("Personal Notebooks" HD/13/E, page 10).

59. In Royal Institution "Personal Notebook" HD/13/E, Davy wrote a "Prospectus of a Work on the Laws of Corpuscular Motion,—or the Philosophy of Chemistry." Here, although "corpuscular" would seem to undermine dynamism, he insists, "the laws of corpuscular motion . . . are of Attraction and repulsion" (page 27 of inverted pagination).

60. Golinski considers how Davy was able to use experiment as a lever to redefine the social relations between experimenter and audience, with the audience reduced to a passive role (*Science as Public Culture* 190–92).

61. How careful Davy was in making ontological claims can be seen in the ensuing remarks: "That chemical & electrical attraction belong to the same bodies is in favour of the idea that they are the same powers exerted under different circumstances but much stronger analogies are wanting to give to this opinion the character, even of a probable theory" ("Electrochemistry" 81).

62. Jonathan Smith quotes Davy's statement that imagination is "merely the vivid but vague association of images with passion" while reason "associates images 'according to facts observed in nature'" (79) and argues that his take on reason is "highly imaginative" (79).

63. He noted in his "Introductory Geological Lecture" that the "active imagination must rest somewhere" (Davy, *Works* 9:188).

64. Ruston points out that Davy imagined light, and its entrance into bodies, as the principle of "perception, thought, and happiness" (*Creating Romanticism* 164–65). At NASSR 2014, Jan Golinksi argued that Davy was initially an enthusiast. In that same paper, however, he cautioned not to call Davy a scientist because "scientist" indicates a kind of professionalism Davy did not and could not, because he wanted to appear genteel, afford to have. In my introduction, I defend my use of the term "scientist."

65. Ruston comments that "Davy would have had access to Kant's work in Beddoes's Library, and that Beddoes had written a review of Kant's *Critique of Judgment* in the May 1796 the *Monthly Magazine*" (*Creating Romanticism* 149). Class details Nitsch's London influence (chapter 1), especially how he shaped Kant so that his German rationality would fit in with British empiricism.

66. Davy notes that when colors are considered beautiful, the "generating imagination makes them hereditary" (*Works* 2: 116).

67. Davy often links the imagination and or fancy of others to error. See Davy, *Works* 4: 5, 14, 16, 216; for the "imaginary" existence of phlogiston, see 4: 29, 163, 166; for heat being imagined as a subtle fluid, 4: 100, 2: 21. The "fertile imagination" of Beccher is somewhat positive, but that is undermined by "conclusions too rapidly formed" (4: 21). De Saussure, too, is praised for having presented "the rare instance of a powerful imagination associated with the coolest judgment" (9: 193). For the errant imagination of the alchemists, see 5: 66. Admitting that he does not know the essence of matter, Davy writes, "Matter may ultimately be found to be the same in essence, differing only in the arrangements of its particles; the results of our operations must be considered as offering at best approximations only to the true knowledge of things" (4: 132).

68. For similar uses, see Davy, *Works* 3: 270, 275, 276, 286, and 302. Davy chided Kirwan because he "imagined" the partial decomposition of nitrate of ammonia (3: 52). Ruston shows in an 1831 letter how Davy used "imaginary fluids" to dismiss phlogiston and caloric (*Creating Romanticism* 163–64).

69. On how the voltaic pile enabled Davy to show his command over natural forces, and to escape the ridicule that came from his earlier experiments with nitrous oxide, see Golinksi, *Science as Public Culture* 203–18. Davy had to redefine Galvanism, away from its associations with mesmerism and French revolutionary hysteria, and toward rational analysis. Ruston argues that these experiments are about the control over pleasure (*Creating Romanticism* 167).

70. Patricia Fara suggests that Marcet may have informed Mary Shelley's understanding of chemistry ("Educating Mary" 21–22).

71. Thanks to Frank James for guiding me through the Royal Institution Archives and for his many conversations with me about Faraday. I am further indebted to him for a careful reading of this chapter, which prevented many errors, and for his encouragement.

72. In a December 1829 letter, Faraday wrote to John Ayrton Paris, "My desire to escape from trade, which I thought vicious and selfish, and to enter into the service of Science, which I imagined made its pursuers amiable and liberal, induced me to take the bold step of writing to Sir H. Davy" (*Correspondence* 1: 497).

73. Daston and Galison note Faraday's strenuous attempts to keep hypothesis and experimental evidence distinct, and they note that his diaries were written up at the end of each day (245).

74. In 1818, Faraday belonged to a self-help writing group, and Alice Jenkins makes the case that Faraday was the author of this paper (26–28). Jenkins announced this discovery in her 2008 book.

75. Sophie Forgan documents Faraday's "principal appeal to the imagination, both public and scientific" (63) in his Royal Institution Lectures.

76. Faraday had this to say about speculation: "Speculations—dangerous temptations generally avoid them—but a time to speculate as well as to refrain—all depends on the temper of mind" ("Speculations" entry Friday, 19 January 1844). Disciplined subjectivity, then, helps control speculation and make it useful. Similarly, Davy comments, "To be attracted to mere speculation is to be directed by a dream. Knowledge can only be acquired by the senses. Nature has no archetype in the human imagination" ("Electrochemistry" 101).

77. In Royal Institution MS F/13/F(2), the abstracts of Faraday's Friday Evening Lectures for 1826–61 note the following: "Not asserting that a new power was concerned [Faraday discusses Brownian motion]; not denying that the powers with which were [*sic*] acquainted might not be sufficient to originate the motion; but thinking it much more philosophical to acknowledge ignorance as to the mode of action in these cases, and to suspend the judgment, than by the assumption of an opinion, which must have been hypothetical, run the great risk of shackling the mind by the admission of error for truth" (71).

78. I am indebted to Frank James for this explanation.

79. Faraday's diaries are in fact his laboratory notebooks. Gooding acknowledges Faraday's "well-known distrust of imagination and hypothesis" ("Mechanics versus Measurement" 5). My treatment shows that Faraday's distrust applied when these were extended beyond their proper reach. See also *Experimental Researches* 1: 142.

80. Recall Kant in *CPR*: "All determination in time presupposes something persistent in perception" (B276).

81. Faraday is drawn to dynamism because it allows him to think in terms of contiguous particles—he defines induction as "an action of contiguous particles" (*Experimental Researches* Dec. 1837)—and because it helps him to account for matter's shifting states.

82. Levere notes that Faraday does not clearly use force to distinguish "between laws and powers innate to matter and laws or powers impressed on matter" (*Affinity* 101). Gooding provides the shrewdest analysis of Faraday's use of force, and he notes that Faraday does not distinguish between actual and potential force, ascribing this failure to Faraday's theology. Dear suggests that Faraday relied upon Newton's claim that since action at a distance was unintelligible, there had to be some physical medium fulfilling the conditions of a line of force (*Intelligibility* 118).

83. I thank Frank James for telling me to pay attention to the shift between series 4 and 5. On Faraday's knowledge of Boscovichean atomism, see James ("Reality or Rhetoric?"). James argues that Davy might have been the source of Faraday's acquaintance with Boscovich's atomism (578–79). Faraday thought that Dalton's atoms had retarded science, but this led him to be read as firmly within Boscovich's camp (584). Even at the dawn of the twentieth century, physicists like Mach hoped to erect science upon a phenomenological base, without the "unnecessary hypothesis of atomism" (Holton 33).

84. On the complications regarding the Faraday's meaning of "contiguous," see James, *Michael Faraday* 67.

85. Nersessian addresses when Faraday had a field concept and points out that scholars have disagreed because they are working with different notions of a field concept. She argues he must have had one by 1832 (182). Harman notes that Faraday introduced the term "magnetic field" in 1845, which was not clearly defined until Maxwell did so in 1865. Maxwell's term meant "the mediation of the forces by the agency of the contiguous elements of the field existing in the space between separated electrified bodies" (72). Gooding shows the ways in which Faraday's lines of force helped him to draw a picture of nature, one that "represented the expenditure of natural powers as processes obeying the intellectual principles of economy and conservation" ("Magnetic Curves" 188). Faraday did not invent "lines of force" and, in fact, in making lines a heuristic, drew from ways of mapping terrestrial fields and geometry (208).

86. For a similar use of "imagine," see *Experimental Researches* 1: 56. Faraday also uses "imagine" when trying to think about where others have gone wrong. See *Experimental Researches* 2: 190, letter to Gay-Lussac.

87. Faraday alludes here to the homopolar disc, developed in 1831. Now called the Faraday disc in his honor, it showed the potential to generate electricity with magnetism.

88. To provide his audience with an idea of how powerful chemical affinity is, Faraday writes, "It may perhaps assist in impressing us with an idea of this power, if we were to imagine a change in the affinity of some one simple body with which we are acquainted. If, for instance, that of oxygene [*sic*] was exalted; combustion would then be more rapid and violent than at present; many bodies would burn which now do not" ("Lectures on Chemistry," 108–09).

89. Faraday explains why the public thought he had taken Signor Nobili's idea: "The circumstances of back date has caused many here who have heard of Nobili's experiments by report only, to imagine his results were anterior to, instead of being dependent upon, mine" (*Experimental Researches* 1: 41n). Faraday's work appeared later because of publication delays (James, *Michael Faraday* 60).

90. In a paper titled "Physical Lines of Force of Electricity," Faraday again highlights his modesty: "With the electric force we have both the static and dynamic state. I use these words merely as names, without pretending to have a clear notion of the physical condition which they seem meaningly to imply" (*Experimental Researches* 3: 410). Morus explains that Faraday increasingly thought that electricity "should be regarded as a force occupying the space surrounding the conductors rather than as a fluid flowing through the conductors themselves" (96). In an exchange between Faraday and William Whewell in February 1852, Faraday sent Whewell a specimen of magnetic curves, asking for his input on what to call them. Whewell suggested the name "sphondyloid," citing Jeremy Taylor's remark that "the circles of Divine Providence turn themselves upon the affairs of the world" (James, *Correspondence* 4: 365). Faraday thanked Whewell, noting that his last letter was "curiously to the point in respect of Jeremy Taylor" (ibid.).

91. Dear argues that Faraday cannot specify what this condition of space is in any noncircular way (*Intelligibility* 118).

92. Faraday turns to the imagination once more in this paper: "I think the analogy with the voltaic battery so placed, is closer than with any case of static electric induction, because in the former instance the physical lines of electric force may be traced both through the battery and its surrounding medium, for they form continuous curves like those I have imagine within and without the magnet" (*Experimental Researches* 2: 424–25). Two points. One, analogy is a way of linking other kinds of evidence to this experiment. Two, continuity itself must be imagined, because the forces might work through action at a distance.

93. For Faraday's speculation that radiation also produced physical lines of force, see his "Thoughts on Ray-vibrations" (*Experimental Researches* 3: 447–52). Here, he argued that the propagation of forces could be represented as vibrations in the lines of force.

94. Levere argues that Faraday was not very much influenced by Boscovich and could not read Latin (*Affinity* 99–102). Harman agrees and thinks Faraday to be far more closely aligned with Priestley (77).

95. "Lectures on Chemistry," dated January 17, 1816, to August 19, 1818, Faraday wrote, "That the attraction of aggregation and chemical affinity are actually the same as the attraction of gravitation and electrical attraction I will not positively affirm but I believe they are and when I again have the honor of appearing before you, I shall give my reasons for such belief" (31). He later claims that the hypothesis of polarity is "of great service to the science, for it enables us to arrange a number of facts which before were insulated and to substitute order and regularity for complexity and confusion" (74).

96. Frank James cautions that Faraday's religious views were not responsible for his rejection of atomism. He points out that Anglicans, Dissenters, and Roman Catholics all rejected atomism ("Optical Mode" 142). On Faraday's Sandemanianism, see James, *Michael Faraday* 12–19; and Cantor.

97. Jenkins omits 5.5 pages of manuscript in her published version of the essay. In these pages, Faraday declares his epistemological modesty and situates the goals of the lecture within the context of the interests of the City Philosophical Society. I quote from the manuscript, and not her published version.

98. Faraday writes a second paper on the imagination. Here he claims that natural philosophy offers many opportunities for the imagination. "What a field for the imagination, (as well as Reason,) is exposed by the powers of the microscope, the telescope, and the discoveries in natural philosophy. How it wanders in the infinite divisibility of matter, or in the immensity of space; how can we restrain it in the contemplation of the heavenly bodies" (Jenkins 65).

99. Faraday opened his 1859 Juvenile Lectures with an illustration of force: he used a string attached to a piece of paper, and pulled on it (*Forces* 6–7). On July 23, 1826, he wrote to Edward Barnard, "I do feel for those who are oppressed either by real or imaginary evils, and I know the one to be as heavy as the other" (*Correspondence* 1: 419). Forces perhaps helped to explain how imaginary evils had real effects.

100. In a letter dated May 12–14, 1813, Faraday wrote to his friend Benjamin Abbott, "Till on a sudden as the dense light of the electric flash pervades t'horizon so struck the thought of Abbott through my soul" (*Correspondence* 1: 53).

101. Anyone attempting to trace Shelley's interest in the physical sciences must begin with Grabo. In what follows, I develop the implications of some of his findings.

Hugh Roberts situates Shelley within chaos theory, arguing that his Lucretian understanding of matter helps resolve the long-standing debate about the relation of Shelley's idealism to his skepticism. Marilyn Gaull offers a useful and crisp overview of Shelley's interest in various sciences. King-Hele quotes Hogg's recounting of Shelley's exuberance with regard to science: "By chemical agency the philosopher may work a total change, and may transmute an unfruitful region into a land of exuberant plenty" (*Shelley: His Thought and Work* 160–61). For an analysis of Shelley's notes on Davy, see Ruston, *Shelley and Vitality* 95–101.

The Pforzheimer Collection at the New York Public Library owns Shelley's annotated copy of G. Gregory's *The Economy of Nature* (Pforz 557R07), given to him in July 1810. To Gregory's definition of matter in terms of extension, Shelley responds, "No one agrees on one definition of matter. By W. D., soul is matter because it is capable of extension but generally is also of sentient sensation" (1: 10). Gregory later names as a law that all matter is subject to laws of attraction and repulsion (1: 16) and dismisses the idea of impenetrability of matter on the grounds that bodies are porous; electricity passes through the densest of bodies and light passes through a variety of substances (1: 10–11). Thanks to Neil Fraistat for helping me suss out Shelley's handwriting and faint pencil markings.

102. For studies that consider Shelley's materialism, see Alan Richardson, *Neural Sublime* chapter 2; Ruston, *Shelley and Vitality*; and Roberts. To Gregory's claim that "the electric matter is visible; whereas the very existence of a magnetic fluid is justly questionable" (1:53), Shelley retorts, "Why may we not as rationally question the existence of electric fluid. It causes certain effects as the magnet does capable of being the subject of our senses—the testimony of them is equally strong in one as in the other" (Pforz 557R 07, 1:53). See also Goldstein.

103. Even such a fine critic as Ruston perpetuates a divide between art and science by distinguishing "scientific exposition" from Shelley's "creative use of science" (*Shelley and Vitality* 105).

104. Reveley's description is printed in Frederick Jones, ed., *Maria Gisborne and Edward E. Williams: Shelley's Friends, Their Journals and Letters*, pages 55–57. In describing the machine as volcanic, Shelley contributes to the development of what John Tresch calls "the Romantic Machine," a kind of machine that becomes organic, self-propelling, and, indeed, more human.

105. Citations of this poem are from Reiman and Fraistat, and numbers refer to lines.

106. Perhaps because the histories of magic and chemistry were so entwined, chemical lecturers followed Priestley's lead in linking chemistry to the sublime but "explicitly not to the mysterious or magical" (Golinski, *Science as Public Culture* 102).

107. Harré highlights the fact that in the late eighteenth century forces like electromagnetism made it difficult to retain atomism (13–15).

108. Tresch's larger point is that since technology has been associated with modernity, Romanticism looks like a dead end. He thus demonstrates how Romantic technology contributes to the history of science.

109. In lines 313 and following, Shelley does threaten to strangle "cones and parallelograms and curves," suggesting perhaps a tension between geometry and the creative imagination. However, Shelley will only strangle them *if* they once dare to

bother him. He concludes that section promising that "we'll make our friendly philosophic revel / outlast leafless time" (lines 319–20).

110. Albert Rupert Hall documents that, in the eighteenth century, cataloguers were aware, if dismissive, of Newton's manuscripts on alchemy (190). My point is that his interest in alchemy was known.

111. For a deft reading of *Prometheus Unbound* within contemporary geological theories, see Heringman. He argues for example that "the fossilized instruments of war . . . appeal to geological stability to represent an end to violence" (*Romantic Science* 71). Yet this is to ignore the counter-spirit entailed within "ruin within ruin," not to mention that the passage ends with "abolished" and "no more" (lines 316 and 318). Moreover, Shelley refers to these fossils as "prodigious shapes / huddled in grey annihilation" (4: 300–301). I shall develop my reading of "shape" below.

112. According to Faraday's 1816–18 "Lectures on Chemistry," "Above gases we come to Radiant matter, and here seem to have the utmost degree of tenuity possible, for even the fanciful ethereal media can not be conceived to surpass it" (150). If Romanticism understood heat, light, and ether as forms of radiant or imponderable matter, we now would call these energy.

113. Frosch writes suggestively that, in this drama, "words are like things or physical forces" (134). Less helpful is his claim that "Demogorgon serves as a gravitational force, bringing the action down to an earthly level, modifying the transcendental tendency of eros and imagination with his own ethos of material process" (217).

Wilhelm Ritter, discoverer of ultraviolet radiation, thought that "light is the external intuition of gravity, love the internal" (cited in Daston, "Fear and Loathing" 85). By making love about the intuition of gravity, he makes it about the phenomenality of the physical. In response to Gregory's chapter on iron, Shelley notes in the margins: "Is there not in nature a continual reorganization of whatever is decomposed?" (Pforz 557R 07 2:178).

Gregory warns against overreliance upon the imagination in accounting for theories of magnetism. He argues, "I am not fond of indulging the imagination in its favorite propensity to create invisible agents in order for the fabrication of plausible theories, which some slight and causal experiment may shortly overturn . . . It is a trite remark, that there are certain points at which the human faculties must stop in all our speculations. This would be a dangerous tenet, if it promoted indolence, or discouraged our ardour in the pursuit of natural knowledge by the only secure path, I mean that of experiment; but it is a salutary maxim when applied to the imagination, and when it only serves to restrain our ardour for fabricating systems, which have no other end but to remove for a moment the uneasy but useful sensation of doubt and curiosity" (Pforz 557R 07, 1:53). Shelley underlines "doubt" twice and "useful" once, and in the right margin submits, "Place a magnet underneath a sheet of paper on which iron filings are spread. What explains the arrangement of these [illegible]."

114. Perhaps Shelley is thinking of Locke here because even Locke defined "mentality . . . as a property of physical structures without being identical with those structures, or without having the same nature as other properties of that structure" (Yolton 200). Shelley's teacher, Adam Walker, insisted that matter albeit inert "attracts and is attracted" (5), and he highlights matter's pores (4).

115. Attention to matter as force allows us to see that Shelley did not limit Pro-

metheus to the One Mind as Wasserman argued in *Shelley*, and matter as force grounds idealism and utopia.

116. Curran argues that Shelley syncretizes physics, pointing out that Orsted was on the cusp of proving a connection between electricity and magnetism. He also mentions Shelley's reading of Volney, from which he learned that ether formed the matter of the stars (108). King-Hele suggests Adam Walker to be the source for Shelley's idea that fire, light, heat, and electricity were one principle; Shelley was shrewd enough to reject Walker's caloric and phlogiston (*Shelley: His Thought and Work* 166–67). Ruston reads the passage where Panthea describes herself as a drop of dew vaporizing as an allusion to the ability of all matter to change form into another, and this, in turn, speaks to a Lucretian understanding of matter as nothing being annihilated, only metamorphosed (*Shelley and Vitality* 113). Where Ruston distinguishes between an absence of love before the revolution and the growth of love after it (125), I underscore that the issue is not presence or absence but apprehension: a dynamic theory of matter demands the apprehension of force/love as the force that holds matter together.

117. Especially useful here is Ruston's point that life as electricity allows Shelley to consider the gendered and political connotations of relationships (*Shelley and Vitality* 115). In an important essay on Shelley's similes, Julie Carlson shows how love is like understanding and like imagination for the poet, and that simile does not predict the outcome of attachment in advance of the attachment (91–93).

118. In *Visions of Science*, Secord argues that Davy uses the form of dialogue to be everywhere and nowhere at once; the various characters all speak from positions Davy was known to have taken (37–41).

119. Rei Terada argues that we would "have no emotions if we were subjects" (*FT* 4): "Emotions require the death of the subject" (ibid.). She means by this to critique the notion of a subject who is driven by teleology, and, under that view, the emotions are importantly moments of self-difference. Shelley thinks about emotions like love as objective forces that must be subjectivized if they are to animate subjects. For Shelley, if emotions make the border between subject and object fungible, they convert subjects to forces in the world whose energies work in the world and give the subject a kind of open subjectivity.

120. In his *Hints Towards the Formation of a More Comprehensive Theory of Life* (*TOL*), Coleridge questions whether crystals, because they have a principle of organization, are necessarily not life. He insist one cannot presume the definition in advance.

121. Although Romantic science was later ridiculed for its reliance on symbols and on analogies, Evelleen Richards shows how these ambiguities were useful to science because it generated a fertile source of ideas and concepts ("Metaphorical Mystifications" 131). Davy of course thought about how judgment needed to preside over the application of analogy. Julie Carlson chides Bruhn for ignoring the affective dimensions of analogy (79–80) and insists upon how analogy enables potential alliances; my insistence on love as attractive force highlights the role of affect. See her "Like Love," opening pages.

122. Goldstein is right that Shelley's understanding of life at times allows it to be mechanical (*Sweet Science*). In act 4, Shelley repeatedly uses the term "unimagined" to describe a utopia in formation that exceeds our imagination, thus associating imagination with limit instead of with boundless transcendence.

123. Wiegand Brothers reminds us that Herschel was a professional musician before he turned to astronomy, suggesting that the arts and sciences were not then as far apart as they are now.

124. Amanda Jo Goldstein and Hugh Roberts thus situate Shelley within a neo-Lucretian swerve that makes necessity unpredictable. I thank her for sharing her *Representations* article with me before publication.

125. For an overview of Enlightenment debates surrounding what counts as an action, see Yolton (chapter 7). Is action merely mechanism? Is human action self-initiating or spontaneous action? Is human action merely godly movement? Does mind cause action, and if so, how does it engage with mechanism? The problem of mechanism continues today in the controversy surrounding Benjamin Libet and his claim that there is an activation of a neural mechanism that prepares the body for action roughly a third of a second before intention. Libet argues therefore that the only free will we have is to decide not to do something we have previously decided to do. Critics note that his choice of action, that of flexing the wrist or bending a finger, is not an action we ordinarily are conscious of, and thus the particular action is not representative of intentionality.

126. See Hogle 230. For a reading of the poem that sees it supporting life as an internal power, and therefore William Lawrence's side of the Abernethy/Lawrence debate, see Ruston, *Shelley and Vitality* chapter 3. She argues that the furies show a misunderstanding of animal life, because they separate vitality from the soul (108).

127. Heilbron insists that Franklin did not discover conservation but that he was the first to exploit it fully (330).

128. On the soul in Romanticism as an entity that moves from an anthropological to an aesthetic object, see Haekel, *Soul*.

129. See my "John Keats and Some Versions of Materiality."

130. Faraday rejects the shape of the atom as hard and fixed, instead adopting Boscovich's argument that atoms are centers of force. The implication of this for shape is that atoms can now have different shapes according to the intensity of forces. See his January 1844 paper, published in his *Experimental Researches* (2: 292). See also his paper on ray-vibrations, when he claims to have given radiation "shape" (3: 452). Amanda Goldstein reads "shape" in the "Triumph" in relation to Lucretian chance encounters and entanglements among atoms, not making them figures of figures, but rather giving figures reality ("Growing Old Together" 73–76). Lucretian materialism offers the possibility of convergence between materialism and trope (63).

131. Schelling argues that matter originally had the property of elasticity and that it could be compressed ad infinitum, making "shape" an ideal referent for matter. See 189–90. Of course, Hegel used "shape," or *Gestalten*, to describe the structures of consciousness in his *Phenomenology*, and key here is that this term is applied to both consciousness and material objects.

132. I agree with William Keach when he claims that Shelley "has to accept and work within the imperfections of ordinary language in order to realize . . . language's potential" to generate thought, but I would add that the dynamic force of matter also helped to generate thought (47). Jacob highlights that, under preformation, "shape" indicates regularity. With epigenesis, "shape" becomes more mobile (57).

133. Cameron, following Grabo, suggested these lines borrow from Herschel's idea

of the formation of solid matter out of nebulae (546). In the Romantic period Pierre Simon Laplace articulated the nebular hypothesis, arguing that the gaseous clouds rotate, collapse, and form planets. I had hoped to include material on Caroline Herschel, who discovered eight comets, but my sweeping through British Library MS Egerton 3761 did not find a single reference to "imagination" as a scientific entity.

134. O'Neill resists deconstruction on the grounds that it is about testing a linguistic theory and not about the imaginative testing of any one writer. Of course, it was never meant to test any one writer.

135. Cameron reminds us that Asia is another version of Venus, the goddess of love. Shelley compares her arrival to Botticelli's *Birth of Venus* (509).

136. Sperry argues that liberation for Shelley is freedom from "inhibition and compulsion" (*Shelley's Major Verse* 113).

137. Under my sense of Shelley's dynamic physics, when Shelley refers to Jupiter's "thought-executing ministers" (1: 387), he worries about the death of thought rather than framing the actions of ministers as the execution of thought. Under dynamism thought is action in another form.

138. Roberts shows how the Lucretian swerve introduces chaos into order, and thus Shelley's interest in Lucretius enables Roberts to see how Shelley profits from simultaneous optimism and skepticism, order and disorder.

139. Demogorgon, for instance, thinks of heaven as "constellated wilderness" (IV.532), implying that even in heaven there is no order without destruction.

140. Wasserman helpfully suggests that Shelley's rejection of dualism "must have driven him to reconsider the function of language, for he could no longer assume it to be an analysis of percepts into the components and relationships obtaining among their counterparts in an outside reality" (*Shelley* 267). Roberts suggests that Shelley's desire to restore the unity of subject and object was fueled by his 1817 reading of Coleridge's *Biographia* (95–104).

141. King-Hele's reading of II.i.71–89 is worth recalling here. Panthea feels Prometheus's love in her dream as if she were a drop of dew vaporizing under Prometheus's beams. King-Hele notes rightly that Shelley focuses on the molecules of the droplets, which dance more vigorously upon vaporization (*Shelley: His Thought and Work* 177), though unfortunately he thinks this is sexual sublimation. It is simultaneously love and force.

142. Cf. my essay in *Romanticism and the Emotions*.

143. Sperry credits John Sewell Flagg for this insight (77, 214n15).

144. Ruston notes that there is sympathy between the emotional and physical in the body of the earth (*Shelley and Vitality* 124). I would add that that sympathy is awakened by the kiss, and that this sympathy verges on identity given love is a force of attraction. Leask argues that earth's inorganic voice makes her resemble "the magnetic influence working on a diseased nervous system" (72–73).

CHAPTER 2: William Blake and the Neurological Imagination

1. Here, I think about how Romantic reductionism enabled traffic between the sciences and the arts. In science, of course, reductionism is generally a term of praise, signifying at minimum the work that science depends on to make objects subject to scientific procedures, and at maximum the deduction of properties, explanations, or

methods from one scientific domain to another. As reductionism crosses into the arts, it often indicates the loss of the human perspective, which, from the standpoint of science, is getting rid of the occult or of introspection or subjectivity. In his study of reductionism, Kandel argues that scientists "use reductionism to solve complex problems" while artists like Turner shift to abstraction to elicit "new perceptual and emotional response in the beholder" (*Reductionism* 6). For Kandel, scientific and artistic reductionism are analogous and therefore should be studied together. Though his is a rich study, his sense that scientific reductionism is not a negation of complexity does an end run around the fact that his work on memory and learning relies on his studies of sea slugs, chosen for the simplicity of their neural circuits. Stengers laments the fact that the "delegation" of matters to scientific experiment was labeled "reduction" in the science wars (*Cosmopolitics II* 213), and this use of reduction amounts to a denial of the creativity within experiment. For a defense of using metaphor between disciplines, see Kellert. To do so, he considers the ways in which science turns to metaphor, despite its protests against figuration, to guide the development of scientific hypotheses (113). Rose and Abi-Rached consider how neuroscience has "move[d] beyond reductionism as an explanatory tool, to address questions of complexity and emergence" (23), but I think this is too optimistic. At bottom, neuroscientists still search for a neural mechanism. Their interest in how neuroscience might lead to new forms of the subject (24) is worth consideration. Finally, Malabou argues that the "neuronal self" is the strength and weakness of current neuroscience: a strength because it is a new idea; a weakness because the continuity between the neuronal and mental is necessarily philosophical and epistemological, not scientific (56).

Blake does most often gender the nerves as male: he frequently modifies nerves with "his." However, his female characters do manipulate the nerves: for instance, in *Milton*, plate 19, "she ties the knot of nervous fibres." And Tharmas is ambiguously gendered. One should also acknowledge that both male and females are "regenerated." See *FZ* N9 E 391: 205–10.

2. The line break is important. By ending the line after "unity," it at first seems completely possible, only to be taken off the table at the start of the next line. References to Blake's *Four Zoas* are to the Erdman standard edition, and typically I specify the night in question, the Erdman page, and then the line numbers.

3. Asma argues that heuristics are "experiential, probable, and approximate," while deduction is algorithmic and produces certainty (71). Heuristics thus encourage feeling.

4. See Cunningham and Jardine, 8, 22. "For all the metaphysical differences between *Naturphilosophie* and the new natural sciences there is a striking commitment in the range of disciplines they sought to unite" (8). According to Edwin Clarke and L. S. Jacyna, "The nervous system provided a paradigmatic case for the vindication of Romantic principles," meaning that the nervous system helped prove the unity of organic structure (43). Alan Richardson shows how Charles Bell was able to "preserve the soul" without "minimizing the claims of the body" (*British Romanticism* 31).

5. In Andrew Lincoln's otherwise quite suggestive study of Blake's *The Four Zoas*, he draws an analogy between Tharmas's fall away from divine vision and the rise of the "scientific universe" of the seventeenth century and Baconian empiricism (72). I show, by contrast, that science has no necessary connection to the fall; Romantic neurology enabled science and imagination to coexist.

6. Rajan's term ("Baudrillard and Deconstruction").

7. Amanda Jo Goldstein argues that Blake's "sweet science" is informed by Lucretian materialism, whereby figuration becomes a central means of empirical knowing and communication (*Sweet Science* 1–9). In this view, sweet science becomes Lucretian poetic sweetness, which allows the science not to seem so bitter. She reads Blake's *The First Book of Urizen* as a critique of life as the power to self-organize (chapter 1) because that organization rarely leads to autonomy. My contextualization of Blake in terms of the neurology of the time suggests alternative paths through these debates. Rather than seeing Blake in terms of a hostility to life, I see him as distinguishing between two kinds of reductionism, the absolute reductionism of Urizen, which can yield only tyranny, and reductionism with a difference that demands pleasure.

8. See Wellmann, who argues that physiology in Romanticism put movement at its center, further ironizing Urizen's backward desire for fixity (152–55).

9. Figlio shows how unity through "organization" enables scientific and philosophical thinkers to attach their diverse beliefs, and he calls attention to the metaphoricity of organization. Jacob allows us to see why it would become metaphorical: "By progressively replacing visible structure, organization provided a hidden foundation for the bare data of description, for the being as a whole and for its functioning" (83). Coleridge, of course, like John Hunter, wanted to consider life "independent of the organization," thus hinting that the word "organization" could retain a materialist taint (*Friend* 1: 493n). On reductionism, see Nagel; and for a critique of Nagel's resistance to ontology, see Schouten and de Jong. See also Changeux and Ricoeur. Robert Richardson notes that reduction to genes can quickly lead to intractable computations as there are more interactions among the genes (125). Eric Kandel argues that reductionism in science does "not necessarily imply analysis on a more limited scale . . . understanding discrete levels of meaning then paves the way for the exploration of broader questions—how these levels are organized and integrated to orchestrate a higher function" (*In Search* 5). In practice it often does, especially since those broader questions must perforce be more speculative and less scientific.

10. See Marjorie Levinson's talk on why lyric poetry should be considered self-organizing systems ("Lyric").

11. Owsei Temkin argues that "passions, instincts, thought and will could be studied as phenomena dependent upon our external and internal sensations, and, therefore, upon our biological organization" ("Materialism" 322). In *Mind's World*, Alexander Schlutz sees the mind's embodiment as a necessary threat to autonomy, but Romantic artists found numerous paths around this problem: one key way was to make embodiment a commitment so as not to be confined by then-current understandings of materiality. For how organization in Blake acquires political resonance, see Makdisi, *Impossible History*.

12. According to the *Blake Concordance*, this is the only use and form of "organize" in the poem. Massey's remarks may no longer pertain: a review of issues of *Neuron* for 2015 shows an interest in neuron "ensembles," "circuits," and "populations" that acquire rhythms when they fire together.

13. Cuvier thought of living bodies as "furnaces, into which inert substances are successively thrown" (1: 5). If Blake's furnaces are a play on this, their irony mounts.

14. Mark Bruhn turns to the work of Francisco Varela to think about how neuro-

phenomenology relies upon "autopoesis": the idea that living systems have a unitary nature, a coherent wholeness, and "an autonomy that is brought forth by the system itself" ("Mind Out of Time" 424). Bruhn thinks about the imagination as "function of a global pattern" of the brain (428), thus turning to organization to enable autonomy. This version of autopoesis requires that the process be "operationally closed" (424). Chemero suggests a more open notion of autopoesis, one perhaps more in keeping with Blake. For an overview of new approaches to the imagination, see Alan Richardson's "Reimagining the Romantic Imagination." Isabelle Stengers argues that with reductionism, in practice, "no one dreams of requiring those 'parts' to actually bear witness to such obedience [of the same laws]" (*Cosmopolitics II* 209).

15. Eric Kandel suggests in *In Search of Memory* why neurons are so capacious: neurons are both chemical and electrical. With long-term memory, not only are new proteins synthesized, but also the number and strength of synaptic terminals can shift from 1,300 to 2,700 (213–16). There is also the number and variety of neurotransmitters to think about.

16. See "How and Where Imagination Occurs in the Human Brain" in *Science Daily* http://www.sciencedaily.com/releases/2013/09/130916162003.htm. My thanks to Marilyn Gaull for calling my attention to this piece.

17. See philosopher David Chalmer's TED talk on consciousness, where he argues that, to think about consciousness as scientific, one may need to risk two crazy ideas. The first is that consciousness is fundamental (a fundamental law), and the second is that consciousness is universal (an argument for panpsychism, which the Romantics found at least for a time attractive). One way to get to panpsychism is to think about consciousness in terms of information (i.e., it from bit). Jaegwon Kim argues that "emergence" is a bit of a dodge. Emergence identifies correlations, which are then not subject to further analysis: it identifies fundamental facts incapable of further reduction (97). This perhaps suggests the ideological work of fact.

18. Might one criticize Malabou's "explosive plasticity" for also lacking precise requirements?

19. After recounting the main theories of how the nerves worked, John Abernethy thought the electrical explanation offered the most "probable account" because it could explain how "motions are transmitted from the tangible extremity to the brain" (*Anatomical and Physiological Lectures* 329). Probability throws a wrench into any deterministic conception of embodiment.

20. Clarke and Jacyna date the start of mechanical reductionism in neurology to the emergence of what they call the "organic physicist" in Germany in the mid-1850s.

21. This holds true even today: consider the current interest in brain waves, or growing curiosity about astrocytes, or the claustrum, which Francis Crick was working on when he died, or rich node neurons.

22. Helpfully, Connolly thinks about Burke as a precursor to Blake in terms of thinking about how the mental and physical interrelate (62–64). Matthew Green argues that Blake synthesized the work of the prophet and scientist; although his "mills" have been taken as destructive metaphors of empiricism, the mills do grind bread (12–13).

23. In 2000, neuroscientist Jean-Pierre Changeux published a series of exchanges with Paul Ricoeur on the brain and ethics. There, he warns against "the presumption of a priori ruptures in discourse . . . which pave the way to irrationality" (23).

24. Catherine Malabou argues that part of plasticity is apoptosis, or cell death: nervous connections that die to enable other nervous connections (19). By making death a form of plasticity, she seeks to resist neuroscience's furthering of capitalism. In insisting upon an explosive plasticity that includes an annihilation of form, Malabou wrests plasticity from flexibility and functionalism. David Chalmers reminds us that "the language of a completed fundamental physics is not known" (*Constructing the World* 110), and thus even physicalism has its limits.

25. Shouten and de Jong question whether multiple realizability really is a problem, since the current success of neuroscience "presumes genuine continuity across individuals and even across species" (12).

26. In July 2017, Frank James and I discussed scientific modeling, and he cautioned me to be wary of imposing a current view of models upon the past. Though they may not have used the term "model" in this way, Romantic neurologists' sense of the tenuousness of any embodiment given to the nerves made their versions of nerves representations, at least, if not models.

27. Rheinberger argues that models to be successful must "leave something to be desired"; the minute they approach certainty, one no longer needs them. Their representational relationship must remain fuzzy (8). Georges Rey argues that we do not know enough about philosophical physicalism; that is, we do not yet know enough to claim a "substantive, explanatory physicalism" (102). He continues, "At best, we have a sketch of a promising naturalistic research program: . . . [a] computer model's version of materialism" (103).

28. Edelman and Tononi have developed an important tool to assess how a group of neurons might be connected to consciousness called the functional cluster index. This index measures the degree of interaction.

29. One of the main problems within literary criticism is the need to render literature bankrupt in advance: sexism, racism, classicism, humanism, colonialism, nationalism, heteronormativism, power. What work of literature can escape these combined charges?

30. Ernest Nagel recognizes an increased skepticism on the part of physicists as to a unified theory but comments that "nevertheless, that ideal continues to leaven current scientific speculation" (336). Reductionism, thus, disciplines the kinds of scientific speculation that are licensed. On the problem of reductionism, see Schouten and de Jong. Its editors note that reductionism in psychology is back in favor again (2). Nagel further warns that reductionism is always historically contingent: on the status of each science, on what forms of reduction each science will find of use for itself and generative of new kinds of experiments (358–64).

31. Gerald Edelman calls absolute reductionism in the form of reducing the human into a theory of molecular interactions "silly reductionism" (*Bright Air* 166); he notes that this was the failure of the Enlightenment. Catherine Malabou in *Self and Emotional Life* argues that neurobiology endorses an essence of subjectivity that has difference at its very core: "The subject is fundamentally, immediately, biologically a stranger to itself, which never encounters itself, which never touches itself" (Malabou and Johnston 34). She highlights the ways in which Damasio points to an autoaffection that is subjectively invisible.

32. Einstein worried about whether "God could have made the world in a different way; that is, whether the necessity of logical simplicity leaves any freedom at all" (cited in Holton xii).

33. Gerald Edelman thus pits the creativity of the imagination against reductionism to Newtonian physics, arguing that the imagination refutes such reductionism (*Bright Air* 170–71). Ricoeur worries that neuroscience, in extending the correlation between organization and function, does away with the need for representation, which he defines as the brain's projections upon the world of "the representations it has organized" (90). Massey warns of the insuperable differences between scientific and humanistic methods, and highlights the humanist's valuing of individual experience of the work of art (chapter 1). Barrett, in insisting upon the subjective differences entailed within the emotions while arguing that the emotions are how we regulate our body energy, suggests that the two approaches are not necessarily at odds.

34. Kleist's *Über das Marionettentheater*, by contrast, marvels at mechanism, arguing that consciousness makes for more wooden dancing. It is worth recalling Kant's remarks that there was not yet enough knowledge about mechanism to know whether it was the same as purposiveness.

35. Patricia Churchland rightly decries as hubris the idea that, just because one cannot imagine a solution, the solution cannot be explained at all (58).

36. See, for example, Churchland's *Touching a Nerve*, chapter 2, where mechanism exculpates the scientist from lazy soul searching. She writes, "Faced with a degenerative disease, . . . we find that mysteries, perhaps hitherto comforting, become instead a wretched obstacle to understanding and hence to possible intervention" (28–29). The problem is that "mechanism" can be its own form of ignorance or mystery, shrouding ignorance under the idea of a mechanism. See also Stinson and Sullivan, who argue that even today neural mechanisms straddle different sciences and different species. So, for instance, they question whether Kandel's work on sea slugs tells us much about human learning. Malabou critiques Damasio's assumption of a continuum between the neuronal and the mental by showing the deep structures of transformation that he has not yet even begun to explain (62–72).

Self-organizing systems include traffic jams or bee colonies or the human circulatory system.

37. For an important overview, see G. Rousseau, *NA*; and Alan Richardson, *British Romanticism*, chapter 1. Ishizuka makes the useful point that Urizen's webs are nervous, and he does so to challenge the equation of him with reason. He separates fiber medicine from the nerves, however, arguing that the nerves were a subset of fiber medicine. I do not see the discourse of the nerves making any kind of hard and fast distinction between fiber and nerve.

38. Even the elements of the brain are not fixed. Rose reminds us that brain proteins are highly unstable and break down: "The average half-life of a protein molecule in the brain is around fourteen days" (140). What does this mean for the materiality of the brain?

39. Manhood of course remains a problem: this intersubjectivity is gendered.

40. Andrew Piper argues that Romantic books were a form of networking, and thus they prefigure our current digital world rather than contrast it. He further turns to Goethe's use of the body to make the book a technological prosthetic space (45–50).

Although never published, Blake's *Four Zoas* arguably parallels a networked text environment with a nervous network.

41. Qualia is about the perception and simulation of subjective differences, which threaten to exceed function, and therefore resist reduction. Lisa Feldman Barrett may offer leads here. She defines emotions as our individual constructions of reality but recognizes that to have force in the world, they need "social reality," which requires "collective intentionality" (134–38).

42. Bruce Wexler argues that social interaction is most important for brain development. See chapter 3 of *Brain and Culture*.

43. Since the relationship of the correlation to causality is always vexed, emergentism may more positively function as a kind of epistemological modesty or bracketing so long as it avoids ontological emergentism and the claim that the emerging complexities will never be known. Although the intentional and qualitative properties of our experience appear to be fundamentally incommensurate with brain matter, this appearance may only speak to the limits of what we can know through our senses. Ontological emergentism is best supported by the idea that complex interactions are more than the simple aggregates of the component parts.

44. Stengers reminds us that although "emergence" began as a weapon against reductionism, "any weapon can be used against its inventor" (*Cosmopolitics II* 209). Ultimately since emergence cannot be disentangled from questions of reductionism, she argues that we must reject thinking in terms of "a judge who has no need of a terrain because he knows ahead of time what that terrain has to say" (233).

45. Edelman and Tononi explore how the nervous system can be integrated and differentiated at the same time. Consciousness is experienced as unified (through "binding") yet is subdivided into individual components (111–12). The subtitle of their study of consciousness is *How Matter Becomes Imagination*.

46. Though syneresis normally requires the elision of one of two contiguous vowels, it is a normal process in which a poet attends to the regularizing of a syllable count. See the *New Princeton Encyclopedia of Poetry and Poetics* (1993).

47. Schliefer argues that wholeness is a quality and function of discourse (xxii), locating the absolute in the tropes that gesture toward it.

48. Nagel cautions that "emergent" does not merely baptize our own ignorance (371). He uses the example of hydrogen and oxygen, whose individual properties do not predict the properties of water.

49. Derek Sankey comments that, "neurologically, we need other selves to become truly our self" (176–77). He overcomes the reduction of the self to neurons by thinking in terms of multiple levels that maintain autonomy. John Savarese argues that literary imagining is "a thoroughly social, outward directed activity" (439).

50. Gigante reminds us that "originally, the concept [of epigenesist] stood for a gradual, internally motivated process of morphogenesis, commencing from what might be called an epicenter" (7). In pointing radically to the external influence upon genetics, Changeux's definition, I suggest, is more in keeping with Blake's. Gigante is quite right to pit epigenesis against preformationism, but she limits epigenesis to "the capacity to deviate from given structures, to harness an internal formative power and branch off on its own during the developmental process" (121). The formative power is internal but very much shaped by the external.

51. Philosopher of science Ernest Nagel argues that reductionism is always temporally qualified even though it is rarely treated so: the reduction has to work with the science of the time (363). Ricoeur argues that "mental experience implies the corporeal, but in a sense that is irreducible to the objective bodies studied by the natural sciences" (Changeux and Ricoeur 15). Changeux responds that qualia have nothing to do with metaphysics, but rather with "an epigenetic signature stabilized in our patterns of cerebral organization" (18). Because Changeux allows for consciousness, Ricoeur does not see him as a "reductionist" (19). Nonetheless Changeux's bent is toward the collapse of a dualism of discourses of body and mind, whereas Ricoeur's is tilted toward an "agnosticism" toward such a collapse.

52. Schuchard notes that, on his visit to England in 1744, Swedenborg turned to a dream journal to encode "his political fears with psychoerotic explorations" (*William Blake's Sexual Path* 77). The parallel is suggestive for *The Four Zoas*. James Hyde's *Bibliography of the Works of Swedenborg* notes that the London Universal Society published a syllabus of eight pages, "proposals for printing by subscription, Emanuel Swedenborg's *Spiritual Diary*" (631). I thank Marsha Keith Schuchard for suggesting that I take a look at this source. Peter Otto ("Drawing Lines") argues that Swedenborg is the key to understanding sexuality in *The Four Zoas*.

53. Blake here anticipates the work of philosopher Evan Thompson, who criticizes the "standard neuroscience conception of the dream state as a form of delusional hallucination." Instead, he argues that dreaming is a "kind of spontaneous imagination" (xxxvi). Thompson's larger project is to think of the hypnagogic state, the state between waking and dreaming, as one that might give neuroscience unparalleled access to consciousness, especially consciousness that includes nonconscious cognition.

54. I am indebted here to a passage in Chemero (43). By radical embodiment, Chemero means to do away with the idea that the mind works through mental representations. He thus sees the environment as directly providing affordances, spurs to action. Chemero is helpful for understanding Blake insofar as the poet does not automatically distinguish between mental representations and embodiment: his imagination is modeled on a kind of electrical mental fire.

55. Thus, the important neurologist Robert Whytt wrote, "The influence of the mind over the body seems much greater than is commonly imagined, and it is not to be confined to voluntary motion, and has a prodigious effect upon such operations in animal economy as are most involuntary and of which we are not least conscious" ("Proposes" file 6). He argued that "different impressions on the thinking principle" alters the quantity and quality of the secretions (ibid.).

56. Alan Richardson notes that for Charles Bell "reductionism could be avoided without resort to a unified, conscious, transcendent subject; the soul could be preserved without minimizing the claims of the body" (*British Romanticism* 31).

57. For information about this work, signed by Blake, see John Windle's *Catalogue* 32. Therein, Robert Essick and G. E. Bentley confirm this copy was Blake's (1).

58. The neuroscientist Jaak Panksepp acknowledges Blake in his chapter "Energy is Delight" in *Affective Neuroscience*. Feeling energetic feels good, and thus emotion is tied to energy.

59. Finger credits Swedenborg with having "anticipated the birth of modern cortical localization theory" (29). Of course, these volumes, dated 1744, languished in

manuscript form until the Victorian period (1882), and thus Blake could not have read them. See Hyde 96–97. However, Blake and Catherine did attend the Swedenborgian church in 1789, and Blake annotated three of his theological works. On the church, see Schuchard, "Secret Masonic History." In one of those works, Swedenborg compares his ideal conjugal love to the two hemispheres of the brain, covered with one meninges (*Sketch* 58). In another, *Divine Love and Divine Wisdom*, Swedenborg describes "innumerable substances and forms in the brain, in which every interior sense, which hath relation to the Understanding and the Will, resides" (35). He adds, "The principles of life are in no other place than where the beginnings of the [nervous] fibres are" (346). In *Treatise on the Nature of Influx; or, Of the Intercourse of the Soul and Body*, Swedenborg blames "ignorance of the offices and formation of the brain" for the idea that "perceptions and cogitations of the mind present themselves to us in organized forms" (52). I do not know whether any of Swedenborg's followers in London had access to these manuscripts, but Swedenborg writes extensively on the brain in his 1795 *True Christian Religion*. He refers to the human brain as a "Form of Divine Truth and Divine Good" (242). I am arguing that Swedenborg's writings on the brain offer a useful heuristic. On the vexed relationship between Swedenborg and Blake, see especially Otto, chapter 6, *Blake's Critique*; and Schuchard, *William Blake's Sexual Path* 78–79.

60. I am indebted here to Lauren Berlant, *Cruel Optimism*, 23–26.

61. Lincoln errs when he claims, "As the circle of destiny is woven into Enion's web, faith becomes fatalism" (74). Enion tries to force the web to mean one thing, but, since the nerves are vital, they resist such impositions.

62. Blake may have derived this image from William Smith, MD. In Smith's 1768 *A Dissertation Upon the Nerves*, he wrote, "The soul is placed by the Almighty in the sensorium of the brain; as a centre in a circle, the nerves are radii, proceeding from that centre" (60). Nicholas Culpeper spoke of the "nervous circle" of the diaphragm in his 1795 *English Physician and Complete Herbal*, thereby hinting at some kind of feedback mechanism. My point here is that although Bell's use of the nervous circle is the most defined connection to a feedback mechanism, this way of thinking about the nerves was present in neurological discussions long before Bell. Ault suggests that in Night 4, "even the word 'circle' has disappeared from the text along with its binding power" (*Narrative Unbound* 163). As feedback mechanism, the circle's binding power becomes more nuanced.

63. Could this have been an early example of brain plaque, now thought to be responsible for Alzheimer's?

64. Lincoln calls attention to the polypus as a hydra, a lower life form. His point is that the image signals how materialism kills even the idea of redemption (246–47).

65. Blake revises the means through which Christ achieves human redemption. In *FZ* (N9 E391: 220–24), he writes:

> Because the Lamb of God creates for himself a bride & wife
> That we his Children evermore may live in Jerusalem
> Which now descendeth out of heaven a City yet a Woman
> Mother of myriads redeemd & born in her spiritual palaces
> By a New Spiritual birth Regenerated from Death

Instead of highlighting Christ's death, Blake here makes Christ's gift the ability to have sex and give birth. In this way, joy replaces sorrow.

66. See Kreiter; and Gilpin.

67. From 1800 to 1803 when Blake was living in Felpham, he had access to William Hayley's library. According to Munby, Hayley owned a copy of *An Inquiry into the Nature and Origins of Mental Derangement* (1798). In that work, Crichton writes, "If symptoms of hypochondriasis are alleviated, no delusion follows: from which it appears that the disease (delirium) is not permanently seated in the brain" (1: 192).

68. Lincoln intriguingly suggests that vales are symbols of faith "that must sustain the mind in the fallow periods between creative activity" (231). This complicates Vala, making her a symbol of faith on the cusp of delusion, so that faith must be questioning, not automatic.

69. Here, one should keep in mind Ngai's point that envy is not necessarily about a lack in the subject feeling it but rather about a perception of inequality (126–27).

70. In Night 1, Blake recognizes that summer heat can make people vulnerable to delusion: "delude by summer's heat they sport in enormous love" (E310: 9).

CHAPTER 3: The Physiological Imagination

1. Peterfreund shows how Coleridge develops his ideas of energy with Saumarez's help (109–11). Coleridge's interest in physiology was sustained. Speaking of imagination later in his *Logic*, Coleridge warns that "a delusion might result, and in many cases necessarily would result, if the knowledge supplied by anatomy or physiology were wanting" (135). Schlutz argues that Coleridge turned to religion "to overcome conflictual models of the relation between reason and imagination" (216). I show how complex this struggle was because religion left epistemological questions of its own.

2. Early on in the *Biographia*, Coleridge insists that even the wildest odes have a logic (1: 9). Barrell argues that Coleridge's famous definition works to sublimate fiery political rhetoric surrounding imagination (epilogue), and I would suggest that physiology gave him tools to try to do so.

3. Thus Kant's *Philosophy of Material Nature* (1783) begins with the question of whether "such a thing as metaphysics itself is at all possible" (1). There he also stipulates, "The imagination may perhaps be forgiven for occasional vagaries and for not keeping carefully within the limits of experience, since it gains life and vigor by such flights and since it is always easier to moderate its boldness than to stimulate its languor" (317). If boldness leads to error, it also indicates vitality, and the problem with vitality is that it is more difficult to stimulate than to contain.

4. Alice Snyder argues that the vitalism controversy raised the issue of the value of hypothesis itself (20). While Einstein thinks of laws as deeply imaginative, Stengers critiques physical laws insofar as they defy ecological thought and rely on states, which falsely abstract dynamic phenomena (*Cosmopolitics I* 87–97).

5. Marilyn Butler's preface to *Frankenstein* claims that Mary Shelley worries about how a principle of life lacks experimental consequences and "yields nothing" (*Frankenstein* xix). As Coleridge recognizes, however, if phenomena can legitimately be correlated to principles, the principles can have scientific weight.

6. In-text citations to Coleridge's *Philosophical Lectures* are to Coburn's edition unless otherwise noted. Physician John Gregory submitted, "The imagination, like

every thing in nature, is subjected to general and fixt laws, which can only be discovered by experience . . . It requires the talents of a person of the most enlarged knowledge of Mankind, to reduce its laws to any kind of system" (*Comparative View* 2: 98). Of course, one man's natural laws could be another's hooey. Recall William James's review of Charles Darwin: "The only 'law' under which the greater mass of the facts the author has brought together can be grouped seems to be that of Caprice" (cited in Müller-Wille and Rheinberger v).

7. Jaegwon Kim shows how today's brain science makes correlations more robust by insisting upon their lawlike-ness. The correlation between mind and brain "must have lawful regularity and therefore are not just co-occurrences" (J. Kim 92). During Romanticism, by contrast, the gap between correlation and identity, partly thanks to Hume, was the engine of skepticism. In *Diotima's Children*, Beiser argues that Baumgarten is able to see sensation as having both subjective and objective aspects because "they are a fact about me, because they are my states of awareness, and because they represent nature from my standpoint" (141). These remarks may shed light on Coleridge's stance to sensation.

8. Mitchell shows how Coleridge's approach to life followed Hunter, in requiring a fundamental shift in mind-set from life as thing to principle (90–92).

9. Schelling allows scientists to have genius. As Robert Richards notes, genius is possible on the condition that the "creative scientific act initially comprehended a whole [system]." Genius in scientific creativity could also be inferred when the individual "formulates ideas that he could not have understood fully" (*Conception* 163–64). Science as collaborative process would inevitably extend the range of any useful idea.

10. Robert Richards reminds us that Kant stipulated genius as the "talent which gives rules to art." Yet, since that talent belongs to nature, it is nature that gives the rules to art (*Conception* 70). This formulation further suggested that physical determinism and human freedom were mutually possible (ibid.), even as it reminded his audience that both art and science ultimately needed to align with human cognitive powers. The problem is that although "the biologist judges an organism to be purposive according to a specific plan of which he can become aware, . . . the art critic judges the painting to be purposive, but cannot specify the plan or rules by which the beauty has been produced" (71).

11. Vickers helpfully situates Coleridge's use of opium within the context of the main physiological theories surrounding it; as he makes clear, every therapy required the testing of theories of what opium actually did to the body (chapters 4 and 5).

12. Kant writes, "Reason is tremendously concerned not to abandon the mechanism nature [employs] in its products, and not to pass over it in explaining them, since without mechanism we cannot gain insight into the nature of things" (*CJ* 411).

13. See Pamela Edwards, *The Statesman's Science*, especially chapter 5. She argues that Coleridge distinguishes between the material moral world and the ideal moral law, in order to provide fixed principles that he defined as assertions one ought to make (116). Material and ideal, however, operate less as binary opposition and more as continuum. She also helpfully suggests that, for Coleridge, Christian moral law was not provable by experiment or concept (116).

14. Pamela Edwards argues that a transcendental idea was for Coleridge not

possible without an embodiment in the world; whether idea referred to thing or merely correlated to a thing is another question. Coleridge submits in his *Philosophical Lectures* that even a "perfect theory" "can never produce more than probability" (359–60).

15. Criticism thus has ironically never taken seriously enough the provisional status of the imagination and its objects. Class shows that one of Kant's key mediators in Britain, F. A. Nitsch, argued that "our notion of free will is not contradictory or imaginary" (42).

16. Coleridge understands facts as being based on laws of human nature such as the fact that we have a conscience. In defining fancy as "a mode of memory, emancipated from the order of time and space" but nonetheless beholden to "the law of association" from whence it receives all its materials, Coleridge made even fancy part of science. To wit, he insisted that it was "modified by that empirical phenomenon of the will" (*BL* 1: 305).

17. See John Gordon's chapter "Doctor Wordsworth."

18. An important work that labors to subject imagination to science is Samuel Hibbert's *Sketches of the Philosophy of Apparitions* (1824). Hibbert dismisses all metaphysical accounts of apparitions, including the existence of a faculty called *Phantasia*. Instead, he argues that "apparitions are nothing more than ideas, or the recollected images of the mind, which have been rendered as vivid as actual impressions" (61). He then applies Humphry Davy's nitrous oxide experiments to hypothesize that a physical change in the blood is the reason why these images get elevated over real images (67–69).

19. Coleridge praises Saumarez for his "masterly force of reasoning, . . . the copiousness of his induction," and especially for having "(in my opinion) subverted the tyranny of the mechanic system in physiology" (*BL* 1: 163).

20. I. A. Richards is worth recalling here. Speaking about how Coleridge draws the line between fancy and imagination, Richards remarks, "The importance and the persistence of the purpose, and the utility of the distinction, establish the line, and it has no other establishment" (76).

21. Coleridge concludes, "the fact of Christianity alone excepted" (*CL* 5: 1235). Here he acknowledges how "external evidence" acquires force "from previous speculative convictions or presumptions" (ibid). Stabler reminds us of the primacy Priestley put on speculation, though even he thought that speculation without experiment was "the bane of true philosophy" (181).

22. Good historical overviews of physiology include Cunningham; Rothschuh; Temkin (all entries); Larson; Jacob; Schofield (*Mechanism*, chapter 9); Jacyna; Beiser; Lenoir; Richards (*Conception*); G. Rousseau (*NA*); Gigante; and R. Mitchell. Lenoir argues that Kant's take on purposiveness influenced physiology, while Beiser and Richards argue that most physiologists rendered purposiveness into an actual cause. How God is imagined to be present in the universe is the subject of Amos Funkenstein's brilliant *Theology and the Scientific Imagination*. On speculation and science, see Robert C. Stauffer, who shows how Orsted, on the one hand, speculated about a unity of forces and, on the other hand, recognized that the theory of unity demanded all the more rigorous experiments to prove them.

When dealing with the "wild Imaginations" of the geologists, Coleridge himself linked "Fancies, Hypotheses, wild Imaginations . . . , even as Women of suspicious virtue are the first to cry out W— —; for they themselves can be acquitted of wild Imaginations on no other plea, than that their hypotheses are too wild even to be imagined" (*CL* 4: 804).

23. Kant labeled "the distinction between truth and hypothesis, and the bounds of the reliability of the latter" as "constitut[ing] the physiological doctrine of method" (*PMN* 308).

24. To successfully cure speech impediments, Thelwall argues the imagination is key: "Interest . . . the imagination; leave nothing obscure or unaccounted for; . . . give him a system on which he can see and feel that he may depend" (59).

25. Pamela Edwards highlights that Coleridge believed mankind to be fallen, and the cause of the fall was a "diseased will," further raising the stakes of physiology (119).

26. The influential teacher of physiology William Cullen noted that physiology encompassed mind and body.

27. John Gregory, by contrast, linked theory and genius/imagination to their mutual detriment: "Men begin to be weary of theories which lead to no useful consequences, and have no foundation but in the imagination of ingenious Men" (*Comparative View* 1: 123).

28. Robert Whytt insisted that only persons of very sensible nervous systems could be affected violently "by force of imagination" ("Proposes"). He later argued that "nervous diseases occasioned by strong impressions on the mind are often prevented, lessened, or cured by exciting other sensations or passions of a superior force . . . Epileptic fits are prevented by whipping" (file 5). Whytt named sympathy the general principle of all the activities of the body, and, as Neil Vickers notes, gave sympathy an Enlightenment pedigree by making it a "mechanical principle" (27).

29. On mesmerism and tractorism, see Harrington; Winter; and Delbourgo (both entries) especially. Harrington calls attention to how mesmerism replaces Christian demonic possession with Newtonian animal magnetism (42).

30. See Bender 288–89. Bender considers how eighteenth-century novels range within the "domain of experience governed by experiment" (288). In the period, experiment could not govern, because it was associated with mere empiricism and the dirty work of one's hands. Bender, working through Dear, argues that experiment made knowledge "contextual, specific, and historical" (289), and I would add simply that these criteria could be a strength or weakness. The Romantic insistence upon feeling allows us to ask to what extent is reproducibility paradoxically about the feeling of conviction: that moment within experience when one senses the experiment has been reproduced.

31. Noel Jackson highlights Lord Kames's interest in how the ideal experience of imagination enables a kind of shared virtual experience. See *Science and Sensation* 85–86.

32. Volta and Galvani began what we now understand to be electrophysiology, but the science of electrophysiology could not be fully in place until the invention of electrometers that could detect the electricity of nerves.

33. See Alan Richardson, *British Romanticism and the Sciences of the Mind*.

34. See *Science and Spirituality: The Volatile Connection*.

35. In his "Preface on the Law of Life," Coleridge wrote, "Many of the worst errors and bewilderments in the History of Physiology have arisen, and still rise, from mistaking this *Ens logicum* for an *Ens reale*, a somewhat existing out of the mind" (*SWF* 1: 575).

36. Holton argues that "hypotheses can never be altogether purged of their origin in the fallible human imagination" (118). Beiser argues that the need to police a hard and fast line between *Naturphilosophie* as a corrupt metaphysics and Kant has had the unfortunate effect of "exaggerate[ing] the speculative and a priori dimension of *Naturphilosophie*, as if it had no concern with observation and experiment, while it downplays the metaphysical interests of those engaged in observation and experiment" ("Kant and *Naturphilosophie*" 10). I would add that, crucially, in Romantic science metaphysics and experiment were not yet framed as an either/or, but this did not mean that then scientists did not have to justify their metaphysics.

37. Coleridge objected to how Malthus tried to make a physical limitation the ground of a moral problem, which was for him an "immorality" (P. Edwards 139).

38. Coleridge classified Bacon and himself as Platonists (P. Edwards 142).

39. Vickers suggests that Coleridge's and Wedgwood's and Darwin's experimental failures had a silver lining: these men could present themselves as the very pinnacles of scientific eminence insofar as they were scientific visionaries, "more sublimely insightful than experimentalists" elsewhere (121). Steinle argues that experiments were not necessarily theoretically driven in the period and thus could be more speculative and exploratory.

40. In *Creating Romanticism*, Ruston relies on Wordsworth's use of fact to distinguish science from poetry (7–8). My introduction argues why facts cannot serve this function. Here Coleridge and Saumarez seek to elevate science beyond mere facts. Although Levere claims that "facts were one refuge from the thinking disease," I show how Coleridge would never have assented to that claim. Levere's suggestion that "the subordination of metaphysics to a practical goal" was another refuge (*Poetry Realized* 39) makes more sense.

41. P. Edwards suggests that for Coleridge, "personal" referred not to an atomistic individualism but rather to the obligations of the personal will to the civic commonwealth (114). In this instance, Coleridge may be alluding to the obligations between individual experiment and experiment as a collective enterprise.

42. See Mensch, who argues that Kant turns to organicism as a heuristic for thought because it allowed him to get away from preformed rules that would put an end to free thought. Rules could then arise epigenetically (10–13).

43. Jonathan Smith points out that those wanting to raise the prestige of hypothesis had to struggle with Bacon's and Newton's hostilities toward it. They thus recontextualized this resistance, showing how their practices obviated their denigration of it, or insisted that Bacon and Newton only decried certain kinds of hypotheses (28–29).

44. Daston and Galison tend to stress imagination as a coquette of pleasure (224). They are right that "vanity seduced natural philosophers into abandoning reality for systems wrought by their own imaginations" (224). Nonetheless, the inculcation of modesty and the idea that hypothesis has no business tangling with the physical nature of things made it possible to think about how to discipline imagination into scientifically useful forms. Orsted makes clear the tightrope that hypothesis (read: imagination)

walks in the period: "As a tentative hypothesis, such a bold conjecture may be tolerated as it might lead to the discovery of what was previously unknown even though it should be regarded as misleading" ("Introduction to General Physics" 299).

45. Reid further argues that hypotheses tend to bias the impartial scientist. Moreover, although simplicity is what allows one hypothesis to triumph over another, Reid insists that nature is complex (Laudan 90–91). The stranger in Humphry Davy's *Consolations in Travel* once again links imagination and hypothesis when he tells Onuphrio, "I beg you to consider the views I have been developing as merely hypothetical, one of the many resting places that may be taken by the imagination" (9: 295).

46. Reid is a precursor of Popper, though of course Reid is influenced by Hume's "problem of induction."

47. Class reads the *Biographia* as Coleridge's attempt to define himself as a Kantian genius who did not need learning but rather imbibed the truth spontaneously (chapter 6). In highlighting Kant's reception as a radical in England, she shows how Coleridge helped transform Kant's and his own reputation into a conservative.

48. Knight argues that Davy thought hypotheses had heuristic value. The problem with atomic theory for Davy is that it could not offer candidates for truth (*Atoms and Elements* 31).

49. Levere records that in Coleridge's scrofula essay, he ridicules the notion of an improved hypothesis when "fancy has been made more active than reason" (*Poetry Realized* 46).

50. Cairns Craig explains that association has received a bum's rap. He argues that "association may be the fundamental principle of the human mind but it does not remain the same in its operations through time: it is a self-enhancing, self-developing process which necessarily grows in complexity as long as the mind is able to recollect and reactivate past experiences" (16).

51. As Nancy Goslee recognizes, Shelley's statement that "the deep truth is imageless" is not a denial of the image's powers but rather "a denial of their claims to an absolute transcendent authority that would . . . deny human creativity" (2–3).

52. Coleridge later writes in *Logic*, speaking of the images of imagination, "The several sciences of hydrostatics, aerology, crystallology, and chemistry, preceded and accompanied by a knowledge of pure mathematics, may be all required in order to legitimate judgment on a single phenomenon, i.e., before the image can be safely declared to possess objective reality—before it can be received with safety as a fact of experience" (135).

53. Timothy Lenoir has noted that the physiology of the time used a variety of teleological arguments, but what they have in common is a recognition of "the special status of biological phenomena and their ultimate irreducibility to physics and chemistry" (9). One strand connected sensibility and irritability to Newtonian forces, but this had the unfortunate effect of reducing physiology to blind forces (ibid.). Another strand dictated that vitalism was an emergent property of biological organization. A third strand, inspired by Aristotle, argues that the universe is fundamentally biological (10).

54. Hence, he stipulates that "intelligence" or "self-consciousness is not a kind of being, but a kind of knowing, and that too the highest and farthest that exists for us" (*BL*

1: 285). Earlier Coleridge toed the Kantian line when he insisted, "We learn all things by occasion of experience; but the very facts so learnt force us inward on the antecedents, that must be pre-supposed in order to render experience itself possible" (1: 142).

55. Timothy Lenoir argues for the influence of what he calls teleo-mechanism during the Romantic period, which intertwined cause and effect so as to make them inextricable from one another. I think Blumenbach eventually gets there, but here he resists it.

56. Empirical evidence is rarely self-evident. Blumenbach must make a case for *Bildungstrieb* and then show us where and how to look for it. Levere argues that the *Bildungstrieb* virtually became a model for the imagination, "raising questions about the relation between imitation and imagination" (*Poetry Realized* 37).

57. Coleridge borrows from Hume the idea of the self as a vantage point from which to see relationality (*THN* 310).

58. Though Robert Mitchell argues that Coleridge's "individuation" is about "emergence, rather than of distinction" (92), my point is that since emergence for Coleridge requires the will, the two will not stay distinct.

59. Barth on Coleridge and miracles and laws is helpful here. He argues that Coleridge did not want miracles to flout natural laws, and yet he wanted laws to be a divine sign that excited wonder (120–21).

60. Scholarly consensus is that Coleridge disagrees with Kant's thing-in-itself, adopting Schelling's skepticism of it. That may be true, but it leaps over much nuance. The passage cited in the *Biographia* is thus: "In spite therefore of his own declarations, I could never believe, it was possible for him [Kant] to have meant no more by his Noumenon, or THING IN ITSELF, than his mere words express; or that his own conception he confined the whole plastic power to the forms of the intellect, leaving for the external cause, for the material of our sensations, a matter without form, which is doubtless inconceivable" (1: 155). First, there are several errors here. Kant insists that things exist, only that we cannot know more than about their form. If appearances are real, it is not clear that Kant is invoking matter without form. Second, Kant analogizes from the ways we process experience the purpose for causality so that there can be some correspondence between subjective and objective, but this is a regulative use of a concept, not a constitutive one. Third, Coleridge is talking about his belief, and thus the standards of argument are not scientific demonstration. Yet my focus here is on what physiology tells him about scientific knowledge and the role of imagination, which must always be about more than mere belief. At very least, Coleridge recognizes that imagination requires some correspondence between the subjective and objective, and that the advantage of thinking about things in and of themselves is that it becomes more difficult to smuggle in *qualitas occulta*. Finally, when Coleridge discusses Schelling, he frames their relationship as a "coincidence," which again resists identity (1: 160). His motivations are partly to defer the charge of plagiarism and the possibility of "an identity of thought" (1: 161), but plagiarism does not explain it entirely, given his patterns of denying identity throughout. Susan Lawrence argues that although scientists may have personally believed in immaterial souls and spirits, they frowned upon appeals to mind and soul within science, and they nonetheless carried on with experiments (330–31).

61. Coleridge comments that Kant in his moral philosophy "was permitted to assume a higher ground (the autonomy of the will) as a POSTULATE," and thus he sees himself as following in Kant's footsteps on this specific issue (*BL* 1: 154).

62. Hanna argues that Kant recognizes how the freedom of the will cannot be scientifically known, but that he ensures its logical consistency with the "true synthetic a priori position which says that the total mechanical system of inert macrophysical material bodies in phenomenal nature . . . have deterministic temporally antecedent nomologically sufficient causes" (23). For Coleridge, if something cannot be scientifically proven, it does not escape the requirements of logic.

63. On Coleridge's division between natural objects and idealism, see Perry, chapter 2. As Perry astutely recognizes, Coleridge mocked himself for his proclivity for retreating from external sense (49). He thus saw the value of the integrity of the otherness of things.

64. Where Barth and others read Coleridge's "primary imagination" in terms of "a sacramental encounter with the mystery of the infinite" (144), I stress performativity and modesty.

65. He will also credit the "system of natural philosophy" with the unity of the absolute, "which is at once causa sui et effectus . . . in the absolute identity of subject and object, which it calls nature, and which in its highest power is nothing else but self-conscious will or intelligence" (*BL* 1: 285). Whatever unity ensues is the product of discipline, system. Note too that Coleridge insists that this unity is "called" nature.

66. Peter Dear reminds us in *The Intelligibility of Nature* that science was preceded by natural philosophy, and the goal of natural philosophy was understanding. During the seventeenth and eighteenth centuries, Dear shows, instrumentality was coupled to the goal of understanding within natural philosophy (9–11).

67. Thus although Trevor Levere argues that for Coleridge "the law of the thing constituted its being and was the ground of its reality" (*Poetry Realized* 100), such designation would not allow Coleridge to distinguish between merely imagined laws and laws that could be corroborated somehow.

68. Coleridge's response to Richard Hooker's claim that "the assurance of what we believe by the Word of God, is not to us so certain as that which we perceive by Sense" is telling here. Coleridge argues, "God refers to our sensible experience to aid our will by the vividness of sensible impressions, and 2nd to aid our understanding of the truths revealed—not to increase the conviction of their certainty, when they have been understood" (*CM* 2: 1133). In turning away from thinking about sensible experience as a form of conviction and in moving sensible experience toward understanding, Coleridge makes space for free will because sensible experience is the work of understanding.

69. See Solomon.

70. P. Edwards argues that Kant thought that reason was hidden under the curtain of phenomena (146). She adds that "the Coleridgean Idea was a living, active thing in itself, something which formed and shaped the material world of phenomena" (ibid.). I would argue that, for Coleridge, reason understands that scientific proof must deal with the gap between phenomena and things, and that reasoned proof is not the same as experimental proof. Moreover, to have a useful idea of what the imagination can do,

Coleridge must refuse minting concepts as things, as this version of the Coleridgean idea can too easily do, or else physiology would constantly be smuggling in the imagination's phantoms.

CHAPTER 4: Obstetrics and Embryology

1. It is worth recalling Veeder's perceptive comment that Mary Shelley's feminism was complicated by the fact that she saw "passivity as a trait essential to womanhood itself" (181). That means her feminism was also self-directed. See also Ruston on Romantic creation (*Creating Romanticism* 97–131). Where Ruston distinguishes imitation from reproduction, I consider how scientific theories of reproduction smuggled mimesis back in. For a feminist reading of the tension between procreation and creativity, see Susan Friedman. Huet argues that Romanticism invests in the idea of a single creator and appropriates monstrosity as a metaphor for the unique. She then argues Romantic criticism replicates "the very structure of monstrosity" insofar as it avoids the question of Percy Shelley's involvement (159). I argue below that Mary Shelley's take on the Romantic imagination was far more critical. Lee Edelman satirizes futurity's reliance upon re-production to model the future, but of course reproduction is creative in its recombinations of genetic material.

2. François Jacob captures the complexities of reproduction when he states that in "a mutation, there are causes which modify a chemical radical, break a chromosome, invert a segment of nucleic acid. But in no case can there be a correlation between cause and the effect of the mutation" (3). But Jacob tells a different story about the history of reproduction, perhaps because he is eager to isolate how generation became reproduction and thus could be studied as a science. He argues that, before the eighteenth century, reproduction was seen as individual creation, a kind of divine engendering. At the end of the eighteenth century, there was a shift to seeing generation as reproduction, and reproduction is defined as a mechanical procedure that science can get a hold of. Müller-Wille and Rheinberger comment about Jacob's claim of a shift that "such creative acts did not have to presuppose a necessarily supernatural *creatio ex-nihilo*" (16). They add, "Yet whatever way one wants to understand creation, it is a concept that does not leave room for a distinction between hereditary transmission and individual development" (16). Development and inheritance thus were not two separate strands of research as they have become with the rise of genetics, which speaks to why I have linked them here. The current rise of epigenetics will once again bring these strands of research into consilience. But within Jacob's narrative of a clear break between the episteme of creation and the episteme of reproduction lies generative crossings that come to light when one looks at how imagination is talked about as both mental conception and generation. Erasmus Darwin in *Temple of Nature* has a long note on hereditary diseases, in which he argues that asexual reproduction is much more likely to produce disease. Here, Darwin has anticipated the value of genetic differences. He ascribes the cause of hereditary diseases of sexual reproduction to excess drink. Choosing the most beautiful persons and ingenious minds will help improve sexual progeny (additional notes 52).

3. In Nancy Yousef's study of Romantic autonomy, she highlights how philosophical accounts of mind abstract social contingencies while character develops out of

interactions with others. The issue of autonomy is complicated within embryology because, from the time of Aristotle through to Harvey and beyond, the embryo is considered autonomous, once procreated, "endowed with the capacity to nourish and fashion itself out of the materials provided by the maternal body" (Müller-Wille and Rheinberger 24–25). Yet, according to Keown, deliberate abortions were not generally prosecuted, because meaningful life did not occur until the moment of quickening, when the fetus's movements could be felt.

4. I thank my colleague, Sarah Marsh, for this suggestion. Golinski argues that Priestley engaged in "literary exposition" designed to make his experiments reproducible (*Science as Public Culture* 77–82). Goethe discusses experimental reproducibility in his 1792 essay on experiment as mediator.

5. The midwife Jane Sharp associated the imagination with sexual desire: it "raised the yard" (21) and "stirs the clitoris" (37). Thus, without it, generation could not occur.

6. Murphy-Lawless demonstrates how the rationality of the man-midwife could be self-protective. One strategy was to make its errors a consequence of female labor as opposed to possible malpractice (86). She highlights the ways in which "obstetric knowledge" was a problematic construct in itself (194). Adrian Wilson argues that the replacement of female midwives by men-midwives in Hanoverian Britain can be explained neither by arguments of fashion nor by arguments about the forceps (*Making of Man-Midwifery*).

7. References to *Frankenstein* are to Marilyn Butler's Oxford edited edition of the 1818 text. Butler's edition lists the substantive changes to the 1831 edition, but in an appendix at the back.

8. Roe suggests that German embryologists like Blumenbach, Kant, and von Baer simply assumed organization and moved the discussion away from the source of organization. Embryology is so important because it is when genotype is expressed as phenotype.

9. According to Churchill, in 1819 von Baer repeated Pander's observations on the chick, identified the notochord as a primary structure, and recognized that Pander's primitive ridges were really neural folds that eventually marked the spinal column (5).

10. Vasbinder argues that Shelley models the monster's development on Hartley, and in particular on his suggestion that cognitive development starts with sensation, moves to imagination, then to ambition, and finally to pleasure and pain (40–43). When Bonnet evaluates hypotheses surrounding generation, he "préfère un système dont la raison et l'imagination s'accommodent également" (3: 55).

11. Wellmann criticizes Roe for emplotting the history of embryology along a trajectory where problems are solved around 1800 (91–93). Instead, she argues that rhythm steps in to work through issues that were emphatically not solved. In her view, rhythm does the work of showing how the theory of development informed development itself.

12. I am indebted here to Roe and Pinto-Correia. The way in which the labors of female parturition was framed needs further examination. Galvani, for example, studied the anatomy of the uterus, emphasizing its nervous connections, endowing it with nervous sensibility rather than with mere brute muscular irritation. Female parturition was thus connected to mind. Haller mistakenly assumed that, since the yolk of the egg preexisted in the hen, that the embryo too preexisted (*First Lines of Physiology* 2: 206–07).

13. Malebranche argued when contemplating animalcules or little atoms, "The imagination is lost and confounded at so incredible a littleness; it cannot catch the vanishing parts, nor take hold of them, as being too little to be grasp'd by it" (14). In this view, since the imagination is powerless to operate at the scale of many of the primary objects of generation, our ideas of them must derive from reason. As he outlines emboîtement, he contrasts the "finite and shallow [human] imagination" against the greatness of divine power: our failure to be able to imagine emboîtement speaks to the frailty of our powers (15).

14. By the end of the eighteenth century, Gasking notes that "preformationism was little more than a power to determine subsequent development" (167). In Alexander Crichton's 1792 translation of Blumenbach's *An Essay on Generation*, preformation has become "evolution" (5).

15. In Atkinson's rhetorical analysis of the Royal Society's *Philosophical Transactions*, he finds a reliance and centering on authors in the seventeenth and eighteenth centuries. Joseph Banks, in particular, sought to protect the society against the nongenteel (30–31). In the nineteenth century, he finds a move toward nonnarrative, scientific objects and more abstraction.

16. Youngquist argues that humanity is not conferred until one participates in civil society (54).

17. Maienschein submits that science alone cannot define when a meaningful life begins (10). On the legal history of abortion, see Keown. Keown argues that Lord Ellenborough's act of 1803 criminalized pre-quickening abortions but made them into lesser crimes. Regular medical practitioners sought to downplay the common emphasis on quickening as the start of life.

18. John Hunter, for example, supposed that the "foetus in utero . . . does not sleep and has no sensation" (John Hunter's Lectures from Mr Cline's Notes, 1, 2).

19. In Humphry Davy's Royal Institution "Notebook on Education and On Nitric Oxide, circa 1800," he argues that the "perceptive existence of the infant" dates back to the feelings in the womb. "The spark of life has been kindled by a number of feelings perceived during the mysterious formation of organs" (3). In this view, the moment when life acquires dignity has been blurred. Musing on her own poverty in 1830, Shelley quotes Thomas Jefferson Hogg's observation that one might as well "be a cabbage as poor" (*Journals* 516). She thus was acutely aware of the precarity of dignity.

20. Janice Cauldwell reads *Frankenstein* as a critique of materialist conceptions of sympathy within the medicine of the time, whereby sympathy is automatic and mechanical and predicated on identity. She suggests the gap between the monster's ugly body and transcendent mind comments on how Romantic medicine struggled to find ways to allow mind and body to work together and to transform sympathy into an active engagement with difference (42). See her chapter 2.

21. A. Wilson argues that William Hunter sought not dogmatic rules but rather to regulate his practice as midwife according to careful observation (361). Hunter credited Haller's observation on the congenital hernia for having "struck [his] imagination" ("William Hunter" 72). Haller's observations helped Hunter to understand the descent of the testicle in the male fetus.

22. According to the patient daybook of surgeon George Furnivall, now at Cambridge University Library, Mary Shelley consulted with him on September 3, 13, 14 and

October 10, 1817, when she had another tonic, and again on May 10, 1819, when she had two ivory nipple shields, twelve teats, and three bottles sent to Rome. Her total account bill was nine pounds. On September 3, 1817, she ordered two shields and two teats, and on September 14 of that year, she had a tonic prescribed (204).

23. On the tenuous position of Scottish men-midwives, see Cody, chapter 6. "It was their ability to step back from the female reproductive body and objectively determine delivery strategy while empathizing with fears and pains of mothers . . . that made them superior attendants to traditional female midwives" (152).

24. My reading of how men-midwives feminized the imagination in order to exert authority over it is in keeping with Barbara Johnson's insight that femininity is monstrous when it embodies contradiction (25), and thus Shelley represents "feminine contradiction from the point of view of its repression . . . in the gap between the angels of domesticity and an uncompleted monsteress" (ibid.).

25. Holmes (327–28) and Mellor argue for the centrality of Aldini's experiments electrifying the heads of dead criminals. Holmes suggests Victor is modeled after the German physiologist Johann Ritter. For a study of how male poets like Pope turn to childbirth metaphors to spark revulsion, see Castle. In Romanticism, the rampant associations of imagination with nerves made the body no longer a necessary source of disgust. If the imagination were physiological, it had effects in the world. Castle also credits neoclassical poetics with an interest in aesthetic purposiveness (201–02), but that was perfectly in keeping with organic function. As she recognizes, in Romanticism, the association of creativity with birth becomes more celebrational.

26. In general, preformationist theories presented the embryo as if it were formed by only one parent, and so there was precedent for this hypothesis.

27. Here again facts cannot stand on their own because they are "assumed."

28. For the anti-vivisection debates, see Guerrini.

29. For an astute reading of the gap between domestic ideology and the representation of domestic mothers in eighteenth century novels, see Francus. She asks why it was then so difficult to represent a domesticated mother and argues that the ideology tried to call the ideal into being and thus motherhood was itself monstrous (14–16). With regard to Frankenstein, Francus argues that Victor is the monstrous mother (44).

30. In a section of his *Autobiography* called "My Private Life," von Baer confesses that he "never felt the slightest temptation to plan a short story, novelette, or still less, plan a novel or drama. Does that constitute proof of a lack of imagination?" (304). Von Baer defends himself from that charge. "But to take something swiftly shaped by the imagination, to hold it fast, slowly elaborate on it dress it in choice words . . . this has always seemed to me the most frightful slavery; that is, unless one intends to present a scientifically conceived opinion in a spirited, graphic and convincing matter" (305). Imagination has a role in science but a limited one: to provide a swift, albeit persuasive, delineation of a scientific opinion. Von Baer thinks the danger of being too beholden to imagination is a kind of slavery.

31. Caspar Wolff discovered that the intestinal tract and the nervous system share the same origin and commented, "This very marvelous analogy—not imagined, but based on secure observations—between parts that are so very different in their nature deserves the attention of the physiologist to the greatest degree" (cited in Wellmann 106). Wellmann notes that Wolff helped make embryology into a science by defining

development as a sequence that is governed by law and variable, filled with repetitions, but of nonidentical processes (107).

32. Devin Griffiths argues that what Darwin means by "rational analogy" is the conscious formalization of unconscious intuitions into conscious patterns ("Intuitions" 654).

33. Hanson thus argues that Shelley here considers "the potentially destructive power of an inadequate uterine environment" (49), and she proceeds to call attention to the darkness of the lab as the paucity of the environment. Are closed wombs not dark? Despite the fact that the monster is the size of an adult and does not grow physically, she connects Victor to epigenesis. I disagree and shall specify why below.

34. Bonnet submitted that the hypothesis of emboîtement startled the imagination without scaring reason (accablent l'imagination sans effrayer la raison) (*Considerations* 1: 2). In his later work, *Essai Analytiques sur la Faculté de L'Ame*, Bonnet granted imagination only the powers of reproducing ideas; moreover, "l'ordre dans lequel les Objets les auront faire naître, determinera celui dans lequel l'imagination les reproduires" (131). Imagination reproduces ideas in the order experienced and thus poses little threat to reason. Gasking notes that Haller objected to Buffon's theory of organic molecules because it relied upon universal geometric patterns that could not account for the range of diversity (88, 108).

35. See Buffon's *Histoire Naturelle* 2: 36.

36. In his long footnote arguing for the existence of the spontaneous vitality of microscopic animals, Darwin refutes Hill without naming him. He writes, "To suppose the eggs of the former microscopic animals to float in the atmosphere . . . is contrary to apparent nature" (*TN* 141).

37. Buffon writes, "On peut nous dire que cette expression, moule intérieur, paroit d'abord renfermer deux idées contradictoires, que celle du moule ne peut se rapporter qu'a la surface, & que celle de l'interieur doit ici avoir rapport à la masse" (*Histoire Naturelle* 2: 35).

38. Goldstein argues that Darwin's filament "is endowed not with self-organizing power but, like Blake's malleable worms, with an exquisite, passive voice receptivity to influence" (*Sweet Science* 56). While Darwin does elaborate on the filament's receptivity to stimuli, he also repeatedly calls it living and associates it with the nerves. I suggest then that susceptibility to influence does not cancel out self-organization, especially since responsiveness to stimuli is part of what it means to be living. Rather, the problem is a fantasy of life as a form of autonomy, in much the same way that political autonomy is a fantasy that ignores our social embeddedness.

39. Paula Feldman and Diana Scott-Kilvert, the editors of Mary Shelley's journals, stipulate that Shelley was attended by the Clarke brothers. Shelley notes that she is visited by "Dr. Clarke." John had been Mary Wollstonecraft's obstetrician and was called in too late after she had contracted puerperal fever. Charles would later insist on the dangers of contamination through dissection and recommend the washing of hands, both of which might have saved Shelley's mother. John retired in 1815 and died in August of that year, making it more likely that Charles attended Shelley in February of that year. Still, it must have been haunting for Shelley to be attended by either John or Charles. See *Munk's Roll of the Members of the Royal College of Physicians*. John Clarke, Mary Wollstonecraft's obstetrician, wrote one of the first studies of children's diseases. In it,

he argued, "Information does not come by intuition or inspiration—the laws of nature, in health and disease, must be attentively studied in order to be well understood, and the life of any man, with every advantage of great experience and acute observation, is too short to admit of his adding much new matter to the general stock" (*Commentaries* 36). Clarke thus pleads for the institutional collection of information.

40. John Haighton warned of the need to distinguish between "life and action. Action is not life but only the effect of life" ("Physiology" 5).

41. Blumenbach warned that the living principle was "not to be imagined as belonging to dead matter" (*Essay* 61). The origins of life remain a problem. In trying to come up with an evolutionary account for consciousness, Antonio Damasio argues that single-cell organisms have "proto-feeling," and that the neuron, as a special kind of cell that influences the behavior of other cells, develops somehow from single-cell organisms (273–74).

42. One strain of *Frankenstein* scholarship dismisses the science in the novel as pseudoscience (Vasbinder, Knoepflmacher), but the lines between these are more nuanced. Another strain identifies who Victor is supposed to represent (Holmes, Mellor). Peterfreund helpfully suggests that Paracelsus makes clear that natural knowledge is related to self-knowledge ("Composing").

43. Bewell ("Issue") argues that obstetricians granted power to the female imagination so that it can create monsters. Obstetricians of the Romantic period had largely debunked this idea, but that does not mean it simply disappeared. One question thus becomes, how does science change belief, and can it do so only insofar as it makes its truths felt?

44. Compare to Malebranche, who argued in *Treatise Concerning the Search After Truth* that the soul has three ways of perceiving: by the senses, by the imagination, and by intellect. "Now what she perceives by the senses affects her much, and takes up all her application; what she knows by imagination touches her less pathetically . . . the reason which may be given for this, is, that the senses represent the objects as present, the imagination represents them as absent" (43). Sharp argued that discontent disturbed imagination, which should be "pure in the act of conception" (110).

45. Vasbinder notes Paracelsus's interest in the homunculus, which he understands to be an artificial man cultured in sealed glass (47). I am thinking of the homunculus in terms of the problem of Cartesianism, the brain that needs a little man with a brain to direct it. In an 1831 journal entry, Shelley wrote, "L'Ame n'en jouit qu'en passant—et sait bien qu'elle n'est pas tranquille que, par un tour d'imagination qu'il faudrait qu'elle conservat mais qui la gêne trop—de façon qu'elle en revient toujours a l'etât qu'il lui est plus commode qui est d'etre agitèe [*sic*]" (*Journals* 514). Surrounded by *ne que*, the imagination only temporarily tricks the soul. Contrast her very careful bracketing of the imagination with Victor's inability to bracket. Holton shows how the scientific imagination has oscillated from Dionysian to Apollonian poles (chapter 3).

46. Ludmilla Jordanova situates the novel within the decline of the "idiom of scientific heroism" (60), which provides another context for thinking about the imagination's role in science. Victor very much wants to place himself in that heroic role and to be worshipped. Victor's faults can also be chalked up to the fact that science was hardly collaborative then, as those who studied nature often worked alone (63).

47. Pinto-Correia shows that Paracelsus, one of Victor's heroes, was a supporter of

preformationism and argues that he was the originator of the concept of emboîtement (33–35). He thought a perfect human embryo could be produced from male semen.

48. For a sustained reading of Darwin's *Temple* as striving for organic happiness, see Janelle Schwartz (34–70). "Lacking any true experiential base, Darwin effectively manufactures one out of the analogue between nature enclosed under glass and the one that generates . . . swarms" (54).

49. In "The Rise of Classical Descriptive Embryology," Frederick Churchill argues that the early embryologists' theories of development betrayed a commitment to "a metaphysics of the organic and inorganic worlds, to a system of causation in mundane affairs, and to the structure of the cosmos itself" (1).

50. When Lavoisier showed respiration to be a form of combustion, Promethean covers inspiration. And when Cuvier called the organism a "furnace . . . to which dead substances are transported successively, there to combine together . . . and to escape one day and once more to become subject to the laws of dead nature" (cited in Jacob 91), he not only brought death and life together, but he also extended the range of the meanings of Promethean.

51. Yousef argues that the monster refutes Rousseau's theory that man is naturally solitary (155).

52. On Darwin and the Eleusinian mysteries, see Primer; and Priestman. Friedman reminds us that Demeter's "physical capacity to give birth serves as a paradigm of all origins" (53). See also Schwartz, who shows how Darwin turns to myth to secure what empiricism cannot (48–63).

53. Yousef connects the monster's awakening to Locke and Rousseau, and notes that, in making the monster feel aloneness, Shelley refutes the doctrine of no innate ideas (152–54).

54. Yousef argues that Shelley thinks autonomy is an "artificial theoretical starting point for human development" (155). She also highlights that Locke misses the possibility that someone else's experience might be different (154).

55. Cody writes that in the seventeenth century it was possible to find an accommodating female midwife who would suggest abortifacients. Society worried about women colluding with one another against men.

56. For Yousef, the monster's size allows him to be "fantastically exempt from this state of infant dependency" (155). Evelleen Richards comments that "the majority of abnormalities or monstrosities were . . . to be attributed to an arrest of development, so that the organism remained fixed into one of those stages through which it ordinarily passed in the normal course of development" ("Political Anatomy" 380). This view allowed monsters to conform to natural laws as opposed to breaking them.

57. In Youngquist's reading, the fault lies with the fact that he doesn't have a proper normal body (48–52). More suggestive, I think, is that the monster's bent on death develops the dark side of the history of medicine (55).

58. William Lawrence argued that "identity or similarity of cause can only be inferred from identity or resemblance of effect" (*Introduction* 171). My point is that how to make the comparisons useful was an open project.

59. The imagination thus might be considered partly in light of what N. Katherine Hayles has called the "cognitive nonconscious." Her examples include termite mounds, algorithms that compose music, and how a grand chess master perceives

checkmate. The analogies this kind of cognition exploits are automatic, a product of neural mechanisms. Yet, despite this origin, it is ultimately how consciousness makes use of the nonconscious cognitions that lends value, and here that use is rightfully understood as creativity or science.

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